JOURNAL of THE SOCIETY OF CHEMICAL INDUSTRY

CHEMISTRY & INDUSTRY

Official Organ of the Institution of Chemical Engineers, of the Coke Oven Managers' Association, and of the Federal Council for Chemistry

which consists of Representatives from

the Chemical Society, the Society of Chemical Industry, the Association of British Chemical Manufacturers, the Institute of Chemistry, the Society of Public Analysts, the Faraday Society, the Institute of Brewing, the Society of Dyers and Colourists, the Society of Glass Technology, the Iron and Steel Institute, the Ceramic Society, the Institution of Gas Engineers, the Society of Leather Trade Chemists, the Royal Photographic Society, the Mineralogical Society, the Biochemical Society, the Oil and Colour Chemists' Association, the Institute of Metals and the Royal Agricultural Society.

VOL. 52 | LONDON, OCTOBER 6, 1933 | NO. 40

EDITORIAL

Science in Agriculture

THIS *issue of the* JOURNAL *contains the concluding* part of Dr. Lauder's address to the British Association on "Chemistry in Agriculture," *comprehensive review of the chemists' work for* griculture that will have been welcomed by many hose labours leave them little time to study a subject *hat is amazing in its scope. It becomes more* nd more evident that the soil is the meeting place f the chemist, the biologist, the mathematician, nd the physicist. Between them in the last undred years they have accomplished a great deal, hether regarded in the light of pure science or its pplication. It must afford a great deal of satisfaction the workers in this field to know that they are conerned with the oldest of all industries, the tillage of he soil. They follow in the footsteps of Jethro Tull nd Bakewell; their brothers now are those workers ho know the fields, the arable land, the downs, and f those "little lanes . . . that wind along and lose hemselves between mossed farms, and parks, and fields f quiet sheep." These men know what it is to be hankful for sunshine, and yet at times to be even more hankful for the downpour that makes the worker in he city miserable in spite of his umbrella and the helter of his office. There is of course another side, anyone knows who has hoed mangels for a week or rudged through mud on a chill January morning to iking. But these things come to be all part of the y's work and the only pity of them is that the men ho take them in their stride now get such small reward. rhaps much the same state of affairs exists with ricultural scientists as with the farmer and his men, very few of them get the public acclamation or the ward that is accorded to workers in other fields. This in some measure due to the nature of the material th which they work. The most ardent agricultural search worker must wait for the seasons, the crops, d the generations, and after years of work may be able do little more than put forward a theory that may verified only in the passing of many more years. e nature of their material makes them adopt such thods as those of Mitscherlich and Neubauer for estimating soil fertility, methods which seem almost fantastic to scientists who are used to working with exact methods. Yet the agricultural scientists have explored to their limits many old bypaths, and have shown the way along many new roads. In the past they might have said and might still say "Courage was mine, and I had mystery." In the future they may be able to complete Wilfred Owen's lines and say "Wisdom was mine, and I had mastery." Writing a hundred years ago William Cobbet asked "What causes real little flat fish . . . all leaping alive, in the inside of a rotten sheep's liver?" and supposed that it was beyond the scope of man's abilities to answer such questions. "Men of sense do not attempt to discover that which it is impossible to discover," he says. Yet to-day the curious life-history of the liver fluke is one of the first things expounded to every student of agriculture. If now we may not be able to grow tea of the quality of Darjeeling on the lower slopes of the Nilgiris, or to supply every soil with its exact requirements of plant foods, yet we are making headway, and much will yet be achieved when there is any sense in achievement. Dr. Lauder, we imagine, might have written several large volumes on the subject chosen for his address. Instead he has given us a nicely concise summary of the chemist's achievements in relation to agriculture such as perhaps exists nowhere else.

Industrial Recovery in America and Elsewhere

Mr. J. Davidson Pratt, the general manager of the Association of British Chemical Manufactures, has recently circulated a report on the American Industrial Recovery during the last two or three months. It seems clear from this report that the great scheme for restoring prosperity to America has accomplished something of value although not so much as its sanguine sponsors originally expected. So far as the chemical industry there is concerned an effort is being made to insure employment for forty hours per week, subject to certain exceptions, and payment at the rate of forty cents per hour, that is 1s. 9d. per hour converting on the basis of \$4.50 to the £. Similar codes have been applied or are being applied to other industries and everything

possible is being done by the Government to make the scheme a success; there has been a certain amount of dissatisfaction resulting in several strikes but unemployment is less now than it was in the early summer and there has been a rise in prices. A more recent account of the latest developments will be found in the September number of *Chemical Markets*, a New York journal which is in a position to record American industrial news fully and promptly: this number gives the proposed code for the chemical industry in full. It is comforting to find that progress is being made in America: we hear also with satisfaction that business conditions are better in Germany: German business men have the reputation of being able and hard-working and we believe that the political events of the last few months have lifted them from the slough of pessimism into which they had lapsed: it seems singular to us that this elevation of spirit should, in the case of some of the German orators and writers, have found expression in very mediaeval, or even primitive, outbursts of nationalism. On the other hand we must not forget that business men greatly outnumber orators and that the views of business men are not sufficiently sensational to deserve reporting in the home press and exporting to foreign countries. Industrial conditions seem to be also better in this country. From all parts of England we have had reports of rather more trade and rather less unemployment. Prices of foodstuffs and general commodities in this country have steadily and slowly risen to about what they were in the winter of 1931–32 and the winter of 1930–31 and on the average they approximate to the prices that prevailed in the year 1913. Probably a gradual increase of wholesale prices will not be a grievous burden to the retail purchaser and such an increase would be a benefit to many industries. We do not expect or desire a spectacular rise; the mechanism of our conditions is so delicate that revolutionary changes upset our nerves, confidence, and reputation.

Medical Research Council

The annual reports of the Medical Research Council are always well worth reading, and that for 1931–32 (H.M.S.O., 1933, 2s. net) is no exception. On the very first page one of the difficulties of medical research work which might not at first be obvious to the laboratory worker is pointed out. Whatever new discoveries are made in physiological, chemical, or pathological laboratories, the new materials and methods need to be tested in the treatment of the living human patient before each new foothold in the medical advance can be regarded as secure. But there is no body of scientific workers in Great Britain which is exclusively engaged in the direct scientific study of disease and its treatment in man which is comparable with that wholly devoted to the laboratory study of the primary medical sciences. Clinical research is one of the primary concerns of the Council, but it offers little reward or security to the research worker, who has generally had perforce to turn his attention to professional practice or the laboratory sciences. The Council has already fully demonstrated the possibilities of a clinical research department at University College Hospital, London, and the endowment of this department by the Rockefeller Found of New York, with consequent liberation of fund similar work elsewhere, is a generous tribute t soundness of the Council's research policy. It is dif to find standards wherewith to express in any quar tive way the importance of the Medical Rese Council's work, carried on by grants-in-aid to wo and by the staff of the National Institute for Me Research at Hampstead. Human suffering cann measured with a yardstick, nor its alleviation in po sterling. We chemists know something of the su and the failure of our own efforts to give the phys and the surgeon new, safer, and more potent drugs, we realize that new medical knowledge can onl based on a foundation of similar successes and appointments, of unlimited patience and courag expenditure of money and labour. It is with un ness, therefore, that we read of the diminution or w drawal of funds from public sources, and with grati born of the realization of danger that we acknowl timely private benefactions in aid of this work. it is not only financial stringency that has checked development of important medical researches; t dealing with malaria, for example, have suffered d trously from the common but erroneous belief Manson and Ross have rid the world of this dis In the British Empire alone nearly half a million ste is spent annually on quinine, and this quantity w provide effective treatment for seven million cases. problems to be solved before the campaign aga malaria can be brought within sight of its goal innumerable; the issues, both vital and financial, immense. Researches on industrial diseases natu claim a large share of our interest. A systematic st is being made of the physical state and chen composition of atmospheric dusts occurring in var industries, and of the effects of dust inhalation, part larly in relation to silicosis and asbestosis and histamine content of dust from cotton card rooms. attempt is being made to ascertain statistically whe inhalation of anthracite or hæmatite dust impairs health and working capacity of operatives. Uniforn of radiological methods is being promoted with a v to improving the diagnosis of pneumonoconioses. Committee on miners' nystagmus has completed work, and a final report has been published. A sur has been made of the physique of men in diffe occupations, and inquiries into the effects of vibra on the human body and on temperament in relation work are being continued. Another investiga concerns the relation of output to efficiency in diffe types of machine feeding and the problems involve conveyor systems, while vocational fitness and accic proneness are also the subject of inquiry. The influe of training, of incentives, of noise, lighting, heating, ventilation on efficiency is acknowledged by every and the studies here mentioned will doubtless af useful quantitative information. There is a b reference in the Report to the work of the Therape Trials Committee, which arranges clinical trials of r remedies which seem likely to be of value in the tr ment of disease, and communicates the results of tests to the manufacturers.

THE TRANSPORT AND FIRE HAZARDS OF LIQUEFIED GASES*

By A. M. CAMERON, B.Sc., F.I.C.

A few months ago a motor lorry conveying a load of liquid chlorine in drums caught fire. As a result, a drum exploded. The base, which was welded to the drum, was blown off, and it was sent with tremendous force off the lorry at one side, and the drum at the other. They were found respectively at a distance of several hundred yards from the vehicle. The occurrence took place in the middle of the night near a village, but on a by-pass road. No damage beyond breakage of windows and displacement of plaster was done, and no one was injured. The drum and its base fell harmlessly into fields. Some alarm was naturally occasioned by this apparently unlooked for hazard, and it was therefore considered that a short note on the behaviour of such liquefied gases in cylinders, when subjected to heat, might be of interest.

Gases may be conveniently tabulated under two headings, viz. :

(1) *Permanent gases : i.e., those in which the critical* temperature is much below temperatures ordinarily encountered and which, accordingly, are never transported in the liquid state under pressure, and (2) liquefiable gases, in which the critical temperature is above ordinary temperature. Such gases, though they may be handled and transported in the compressed state are usually now dealt with in the liquid state in order that the maximum possible weight of gas may be put in any container.

The most commonly met with permanent gases are, of course, hydrogen, oxygen, and nitrogen.

The laws governing the pressure developed in a cylinder of a permanent gas are relatively simple, being those of Charles and Boyle. By the former, the volume occupied by a gas, if heated and free to expand (i.e. if the pressure is constant) increases by $\frac{1}{273}$ for each degree of rise of the absolute temperature (zero = −273° on the Centigrade scale), so that a gas at 273° C. occupies twice the volume that it does at 0° C. By Boyle's law pressure is inversely proportional to volume, *i.e.*, if the volume is halved the pressure is doubled.

As both laws are in operation at the same time, if we heated up a gas from 0° C. to 273° C., allowing it to expand and then (still keeping the temperature constant at 273° C.) compressed it to its original volume, we should double the pressure as compared with that at its expanded state, which would be that of the atmosphere. This is exactly what we do when we heat up a cylinder of gas to 273° C. We have not allowed the gas to expand and then compressed it, but have maintained it at its original volume. The rise in pressure is thus proportional to the absolute temperature.

In the case of a cylinder of a permanent gas, though the pressure rise owing to a rise in temperature may be high absolutely, the increase will be comparatively small relatively to the original pressure. Thus, if the original pressure were 1500 lb. per sq. in. at 0° C., a rise in temperature to 273° C. would raise the pressure to 3000 lb. As such cylinders would ordinarily be tested to this figure or rather higher, danger would not arise till this temperature were exceeded. The heat might possibly produce some weakening effect, but the *temperature would ordinarily have to be raised above* 300° C. for risk of an actual explosion to take place. While such temperatures would easily be exceeded in a fire involving buildings, in the case of fires in transport, such as a lorry fire, there would be a fair chance of the cylinders coming through it in safety, particularly as some time would elapse before the heat was conducted through the thick walls of the cylinders.

Let us consider the case of gases transported in a liquid form. It should first be noted that we are dealing with a much larger weight of the gas and thus potentially with a much larger volume of gas if it be liberated. Thus, a cylinder of 1 cb. ft. capacity, if filled with oxygen at a pressure of 120 atmospheres, will contain about 11 lb. of oxygen. A cylinder of *liquid chlorine, on the other hand, of the same size*, with a filling ratio of 1·24 (by filling ratio is meant lb. weight of liquefied gas for each lb. of water capacity of cylinder), will contain 62·5 × 1·24 lb. of chlorine.

If a cylinder of liquefied gas be heated, internal pressure may rise from several causes :

(1) The vapour pressure of the liquid rises as the temperature rises.

(2) If the temperature rises above the critical temperature of the gas the whole contents will be converted into gas and the cylinder will thus be filled with a very large quantity of gas.

(3) At temperatures below the critical point, the liquid itself expands fairly rapidly. No pressure due to this can develop till the liquid entirely fills the cylinder, but as we shall see, with the filling ratios at present in use, this can occur in the case of some gases at a comparatively low temperature.

To consider these three heads seriatim :

Vapour pressure.—With a gas of high critical temperature such as chlorine (critical temperature 144° C.), the vapour pressure is not high at ordinary temperatures, being with chlorine 72 lb. gauge pressure per sq. in. at 15° C. It rises with the temperature, but at 70° C. it is only a little above 300 lb. With chlorine therefore, unlike the case of the permanent gases, the cylinders at ordinary temperature and for a considerable rise above it, are only subjected to a moderate pressure, far inside the safe limit.

With gases of fairly low critical temperature, such as carbon dioxide (31·1° C.), the vapour pressure is relatively high at ordinary temperature (735 lb. absolute at 15° C. for the pure gas) and, as the liquid will all become gas at 31·1° C., it can only show a vapour pressure through a small temperature range.

It must be remembered that for any given temperature, provided *that both liquid and free vapour space are* present, the pressure will remain constant, irrespective

* Read at the Tenth Annual Conference of the Institution of Fire Engineers at Blackpool, September 28, 1933.

of the relative amounts of liquid and vapour. That is to say a cylinder of liquid gas in this respect resembles a steam boiler.

Vapour pressure therefore is not a source of great hazard under ordinary conditions.

Behaviour at critical temperature.—At the critical temperature the whole contents of a container will become gas, irrespective of the pressure. The weight of gas will be much greater than in the case of a permanent gas. Thus with carbon dioxide the weight will amount to about 47 lb. at a filling ratio of 0·75, for a cylinder of 1 cb. ft. capacity. This, if free, would occupy about 420 cb. ft. at 31·1° C. If a gas near its critical temperature obeyed Boyle's Law, this would mean that the pressure would rise to 420 atmospheres, which would much exceed the safe limit. A gas fortunately does not obey the law when near its critical point, but the curve of increasing pressure rises steeply, with the temperature. In the case of carbon dioxide the critical pressure (*i.e.*, the pressure at the critical temperature) is 73 atmospheres, but at 55° C. pressure has risen to about 200 atmospheres and at 75° C. to something like 290 atmospheres (for a filling ratio of 0·75). In the case of a permanent gas the increase in pressure with a rise in temperature from 31° to 75° C. would be less than 15% as against 300% in the case of carbon dioxide. This consideration is naturally of most importance in the case of gases of relatively low critical temperature such as carbon dioxide (31·1° C.) and ethylene (9·7° C.).

Expansion of liquid.—Liquefied gases have a large coefficient of expansion, *i.e.*, their volume increases rapidly with rise of temperature. Though the liquids are fairly compressible, nevertheless if the liquid entirely fills a container, the pressure rises rapidly. Thus, to consider the case of chlorine, with a filling ratio of 1·25 the percentage of free space at 45° C. will be 6·3%, *i.e.*, the liquid will occupy 93·7% of the volume of the cylinder. The filling ratio actually used for chlorine is 1·24, slightly less. By referring to the table given in the Fourth Report of the Gas Cylinders Research Committee (Home Office) (from which most of the figures given in this paper have been taken or calculated), it will be seen that with this ratio the vapour pressure in the cylinder is 86 lb. absolute (equals 72 gauge) at 15° C. This will be the only source of pressure, except the slight pressure due to the actual weight of the liquid, and will be exerted all over the interior of the cylinder. But observe how the pressure rises with increase of temperature:

At 15°	86 lb.
25°	112 ,,
40°	168 ,,
60°	267 ,,
70°	329 ,,
75°	595 ,,
80°	1055 ,,
85°	1505 ,,

Between 70° and 75° C. the liquid has completely filled the cylinder, and liquid pressure has begun to show itself.

Though the liquid is to a considerable extent comprehensible, the pressure rises rapidly with increase of temperature, once the liquid fills the cylinder. While the pressure rises to only a very moderate figure till this point is reached, once filled with the liquid the mean pressure rise is at the rate of 92 lb. per sq. in. for every rise of 1° C. Thus, while it has risen by only about 500 lb. while the temperature rises from 15° C. to 75° C., it rises by over 900 lb. for a further 10° C. rise of temperature. Before the critical temperature is reached (144° C.), the pressure will have risen to a figure far in excess of the tested pressure of the container. The pressure rises from a quite safe figure to a highly hazardous one through a very narrow temperature range.

The above are the figures for chlorine, but those for other gases with high critical temperature, *e.g.*, sulphur dioxide (C.T. 157° C.) and ammonia (C.T. 132° C.) are of a similar order. The pressure from the liquid will rise to an impossible figure at a temperature not very many degrees above that of the boiling point of water.

Chlorine is usually conveyed in drums of size about 5 ft. × 2 ft. 6 in. (sometimes a little larger), the base of the drum being welded in and concave or "dished." A pressure of about 1200 lb. or a little more will cause a reversal of the "dishing," so that the base becomes convex. With the standard filling ratio this pressure would be reached at about 82° C. A rather higher pressure would be necessary to blow out the base, but it is obvious that the temperature range from complete safety to great hazard is very short. No danger at all would need to be anticipated if the temperature of the liquid chlorine did not rise above 70° C., while if it rose above, say, 110° C. (or perhaps a lower figure) highly hazardous conditions would have arisen.

The fact that a drum will contain a considerable weight of chlorine gives rise to a toxicity hazard in the event of an explosion occurring in a crowded street or other such locality. A drum of the size mentioned will contain some 1900 lb. of chlorine (= 9500 cb. ft of gas). When the figures of the toxicity of chlorine are remembered, it will be seen that such a quantity would be a source of hazard if suddenly liberated.

When a drum or cylinder of liquefied gas becomes involved in a fire, the essential thing is to cool it down as quickly as possible, or if fire appliances can be got to the spot rapidly, to prevent the temperatures of the cylinders rising.

To this end a jet of water, as copious as possible, should be directed on to the container. Avoid local cooling by a small jet, as this would cause a strain, from the different parts being at different temperatures. Manufacturers of liquid chlorine were asked whether there would not be a risk of a sudden jet of cold water giving a dangerous shock to a hot cylinder, but, while agreeing that a certain strain from this cause would ensue, they considered that the risk would be relatively slight compared with that of the container bursting. The essential thing was to cool the cylinders down.

The question arises as to the probability or otherwise of hazardous temperatures being at[illegible] during transport. It must be remem[illegible] to the thickness of walls of containers, the heat from

fire will be conducted to the contents relatively lowly. In the event of a single lorry being involved, here would be a reasonable chance of the containers oming through without bursting. In the case cited, wo of the three containers did so. But obviously no ne could guarantee that a fire involving even one orry would not be sufficient to cause an explosion, henever such a thing occurred. Two or more vehicles night be involved as the result of a collision. Everyone ill be able to recall a serious fire of such a nature.

The position as it stands therefore, is that here we ave a hazard that does not seem to have received full onsideration by the different interests concerned. The uestion of preventive measures may be considered. t is unnecessary to say that to hope to render the ansport of cylinders of gases, whether compressed or quefied, safe under all conditions is a counsel of erfection. While we continue to enjoy the conenences such afford, some risk will always be present. he question is how to afford the greatest practicable itigation.

In the case of a relatively harmless gas, such as arbon dioxide, the provision of thin metal safety bursting discs" may be practicable. Such are used n industry for a variety of purposes. Their use in the ase of highly toxic gases is manifestly impracticable. he point to bear in mind is that vapour pressure in e case of gases with a high critical temperature (*e.g.*, hlorine, ammonia, sulphur dioxide) is relatively low ven at the critical temperature, and as has been entioned, even above that point, there is a temperature nge, while the gas is beginning to obey Boyle's and harles' Laws, during which pressures will not rise to azardous figures. If then we could eliminate pressure ue to the liquid filling the cylinder completely, the nditions would be that cylinders of liquefied gases of igh critical temperature would have a safe temperature inge that was not so very much shorter than those of mpressed gases.

The question arises, therefore, as to whether it is racticable to reduce the filling ratio to such a point at the liquid will not exert dangerous pressure at any mperature under the critical temperature. Owing to riations of rate of expansion and compressibility with se of temperature, calculations, unless data are availle right up to the critical point, are not exact, but it ould seem that in the case of chlorine, a reduction of eight of contents of 20% to 25% would achieve this d. In the cases of gases of low critical temperature, *g.*, carbon dioxide, ethylene (9·7° C.), nitrous oxide ·5° C.), limiting the filling ratio has the effect of eping down gas pressure in the event of the temperare rising.

I have in this paper given chief consideration to lorine, as this gas is now so widely used in industry, ving to the convenience of an available supply in the quid state. While not desirous of sounding an alarmist te, I think that the figures I have given show that it highly desirable that further consideration by all ned should be given to the question of e f liquefied gases, not only from the emical and physical point of view, but also as regards ansport conditions.

NOTES ON MR. CAMERON'S PAPER

By T. J. DIXON, B.Sc.*

Mr. Cameron's paper, in so far as it deals with the purely technical matters relating to the physical properties of gases under various conditions of temperature and pressure, contains statements which are based on indisputable scientific facts. And before going on to discuss new suggestions which have the very laudable object of reducing hazards involved in the transport of gas containers, it should be pointed out very clearly that the regulations and general procedure at present in use are based on the very careful consideration of (among others) the facts quoted by Mr. Cameron. Investigation into all the known data relating to the physical behaviour of the gases commonly used in industry was made by the Gas Cylinders Research Committee of the Department of Scientific and Industrial Research. This Committee, consisting of a number of eminent scientists under the chairmanship of Prof. H. C. H. Carpenter, F.R.S., after considering the problems involved, embodied in their Report recommendations to cover the safe transport of liquefiable gases in cylinders. The work of this Committee was extended at a later date by the Committee on Welded Containers (under the same chairmanship) to make recommendations regarding the transport of gases in welded containers of larger capacity than the cylinders which had been considered by the earlier Committee. The recommendations contained in the Reports of these Committees form the basis of the regulation and general procedure at present followed in relation to the design, construction, and use of containers for compressed gases. The constitution of these Committees was such as should satisfy anyone that regulations and procedure based on their recommendations must be the best that existing knowledge could supply. I have stressed this point relating to the D.S.I.R. Committees in view of the statement in Mr. Cameron's paper to the effect that the hazards connected with the transport of compressed gases do not seem to have received full consideration by the different interests concerned. Since reading the paper I understand from Mr. Cameron that this statement was intended to refer to fire risks only, but as this point was liable to misinterpretation I have thought it right to enlarge somewhat on the actual facts concerning the careful thought bestowed on the problem.

To consider now Mr. Cameron's suggestion that the filling ratios should be reduced, this question of filling ratios, as Mr. Cameron states in his paper, received very careful consideration by the Committees of the D.S.I.R. In fact a substantial portion of their Report is devoted to the considerations which led them to the recommendations which are now followed in practice. The effect of temperature on the safe filling ratios for various gases was assessed by consideration of the maximum temperature to which the gas in a container could possibly reach under normal conditions. It is true that any abnormally high temperature, to which the gas could be exposed only in the event of an accident, was not taken into consideration. And this course is the only practical and reasonable one to adopt, as it would be impossible

* I.C.I. (General Chemicals) Ltd.

to construct compressed gas containers which would be safe under all the conditions which might arise if the containers were subjected to an uncontrollable high temperature. It is true that, as Mr. Cameron states, the rise of pressure with temperature above a certain critical point is very rapid and reaches a dangerous height for a comparatively small temperature rise. But this is a characteristic of liquefiable gases (from this point of view an unfortunate one), and the evasion of it by reducing the filling ratio would, in all probability, place the transport of liquefied gases outside the bounds of practicability. Not only so, but even to reduce the filling ratio by the amount suggested by Mr. Cameron would not by any means *remove* the danger arising from a fire, but would only reduce this danger slightly by raising, to a relatively small extent, the temperature at which the gas container might fail. In other words, it can be said that, under present conditions, containers carrying liquefied gases are perfectly safe under normal temperature conditions, but that, like many other things, they are a potential source of danger if involved in a fire. Even then, although no one would wish to disregard or even to make light of a risk, it is easy to form an exaggerated idea of the danger involved. Thus, in the case mentioned by Mr. Cameron, which, it should be pointed out, is the only one of its kind which has occurred in spite of the enormous number of compressed gas containers in everyday use, although three cylinders were involved in the same fire, two of them withstood the very abnormal conditions, whilst no personal injuries were sustained by anyone as the result of the failure of the third cylinder. Furthermore, with regard to the point raised by Mr. Cameron in connexion with danger due to toxicity when a container fails, the evidence is that a fire, which will cause a liquefied gas container to fail, produces such a large up-draught that the gas liberated from the container is carried upwards, almost instantaneously, and rapidly dispersed at such a height that it is harmless. This happened in the case mentioned by Mr. Cameron, when not even a smell of chlorine was reported.

It having been shown that it is not possible to remove, or even appreciably to reduce, the danger arising from compressed gas containers when exposed to a fire, it is clear that the only way to tackle the problem is to reduce to an absolute minimum the risk of a fire occurring which would endanger the cylinders in transport. Petrol-driven vehicles, owing to the inflammable nature of their fuel, are an obvious fire hazard. And in this connexion it may fairly be remarked that the transport of inflammable liquids constitutes a potential danger in case of fire far greater than that arising from the subject under discussion. A considerable increase in safety is obtainable by the use of vehicles driven by heavy oil engines in place of petrol driven vehicles. A further point is that fire-proofing of the woodwork of the vehicle will undoubtedly reduce considerably the danger from fire. Again, there is evidence that fires on motor vehicles have arisen through the very usual practice of fitting twin tyres to the rear wheels. Deflation of one or both tyres will allow the walls of the tyres to rub against each other, the resulting friction generating sufficient heat actually to set fire to the tyres, and so to the body of the vehicle. All these points have been given full consideration by Imperial Chemical Industries, Ltd., and action on these lines was taken some time ago. In certain cases existing vehicles have had their petrol engines replaced by heavy oil engines, and further heavy oil-engined vehicles have been purchased; timber, fire-proofed by impregnation with mon-ammonium phosphate, has been adopted for the platforms and other wooden parts of the vehicles; and in certain cases large single tyres have been fitted to displace twin tyres. (The question does arise to what extent attention should be given to the fire-proofing of woodwork on motor vehicles by carriers and also by motor manufacturers.) As further precaution, a regulation has been in force for a number of years which insists that vehicles carrying liquefied gas containers must be equipped with fire extinguisher and gas mask for use in case of emergency. In addition, the driver of the vehicle is handed a printed instruction card containing clear directions as to what he should do in the event of fire or other accident which might result in leakage of gas from a container. On leaving the works the driver is required to sign a statement to the effect that he has a copy of the "Accident Instructions," and that he is equipped with fire extinguisher and gas mask and knows how to use them.

I trust that the foregoing reference to the precautions which are being taken at the present time will be a sufficient reply to Mr. Cameron's statement in his last paragraph, and he can rest assured, as regards the future, that the very closest vigilance is being kept, and will continue to be kept, on all matters relating to the safe handling and transport of liquefied gas containers.

CHEMISTRY AND AGRICULTURE

By Dr. ALEXANDER LAUDER

(*Concluded*)

Biochemistry

When we consider the development of organic chemistry during the past century, we see that the earlier workers were much occupied with the investigation of the substances which occur naturally in plants and animals: although many individual organic substances were known before this time, the modern developments of organic chemistry may be said to date from Wöhler's memorable syntheses of oxalic acid in 1824 and of urea in 1828. While the early organic chemists were much interested in those compounds which occur in plants and in the animal body, the trend of investigation, particularly in this country, then shifted to the investigation of more theoretical questions, *e.g.*, the investigation of radicles, the theory of substitution and types, and the theory of structure. These investigations gave a great impetus to organic synthesis, and the number of known carbon compounds increased rapidly. Most of the substances investigated, *e.g.*, the many products obtained from coal tar, had no connexion with animal or plant life, and organic chemistry became much more the chemistry of the carbon compounds than that of living organisms. Until the beginning of the present century the interest in the chemistry of natural products steadily declined, and it is only since then that the development of biochemistry,

as we know it now, may be said to have taken place. The monumental work of Emil Fischer on the purines, the simpler carbohydrates, the proteins, and the tannins, to which he devoted the greater part of his life, laid the foundations of this new branch of the science. His method for the separation of the amino-acids by first converting them into esters and then separating the esters by fractional distillation under greatly reduced pressure, has been invaluable in the study of this group of substances. By 1906 biochemistry as a separate branch of the science may be said to be firmly established, and in that year three journals devoted entirely to biochemistry appeared in Britain, the United States, and in Germany respectively. The work initiated by Fischer has been carried on by a brilliant band of workers in this and other countries, amongst whom may be mentioned Perkin, Willstätter, Gowland Hopkins, Robinson, Barger, Haworth, Windaus, Wieland, Hans Fischer, and Dakin.

It is obvious that the investigation of the chemical changes which take place in a living cell presents difficulties of a very high order. The reactions involved take place in very dilute solution; the intermediate bodies formed have a very brief existence, being rapidly changed into some further product: so that, while we may know the initial substances involved and the final product of the reaction, there may be little known as to the various stages in the formation of the final product.

While there have been great advances in our knowledge of the structure of many of the substances found in plants and animals, we still know relatively little about the processes by which they are formed. The various stages in the fundamental process of photosynthesis have not yet been worked out, although plausible suggestions as to what takes place have not been wanting. We are ignorant of the stages by which amino-acids in plants are formed from nitrates and carbohydrates, and little is known of the methods by which carbohydrates are changed into fats and *vice versa*. In the same way, while we have a considerable amount of knowledge as to how the proteins, fat, and carbohydrates are broken down in animals, little information is as yet available as to how similar changes are brought about in plants. A notable recent advance is Robinson's theory of the way in which alkaloids are synthesized in plants, which has enabled him not only to predict the constitution of certain alkaloids, but also to effect the synthesis *in vitro* of alkaloids and alkaloid-like substances.

It is interesting to note in passing, that where individual instances of katabolism have been worked out, the breakdown does not occur, as a rule, in the manner which the organic chemist would expect. The same is true of the degradation of the amino-acids in the animal body.

In a series of lectures on the amino-acids, proteins, and the proteolytic enzymes recently delivered in this country, Prof. Max Bergmann of Dresden describes the recent advances which have been made in our knowledge of the amino-acids and the polypeptides, as well as of the changes brought about by the enzymes which attack them. He shows that for more than thirty years chemists have been endeavouring to discover suitable methods for the synthesis of peptides containing the more complex amino-acids, but that only recently has a general method been developed. It is generally assumed that in the proteins the amino-acids are linked together by condensation of the carboxyl group of one amino-acid with the amino group of the next, a molecule of water being eliminated and an amide or peptide linkage formed; the ordinary protein molecule is supposed to consist of a large number of such linkages. Bergmann points out that the outstanding problem of modern protein chemistry is to determine the effect of combination in peptide linkage on the different amino-acids, and, secondly, how the nature of the peptide linkage itself is influenced by the character of the amino-acids which take part in its formation.

Investigations along these lines, while yet in an elementary stage, have thrown much light on many of the biological processes, *e.g.*, the transformation of an amino-acid to a fatty acid, the biological degradation of an amino-acid to a keto-acid, and, conversely, the biological synthesis of creatine and many other reactions of the highest importance. Willstätter, Waldschmidt-Leitz, and Bergmann and his fellow-workers have also devoted much time to the action of the enzymes which attack proteins and have made significant advances along this line of work. Summing up, Bergmann states: "The key to present-day and future protein chemistry lies in the development of new synthetic methods, in the action of enzymes on proteins, and on an extension of the knowledge of protein metabolism both in normal and pathological cases."

Similar advances in our knowledge of the structure of the carbohydrates have also been made. The work of Purdie and Irvine at St. Andrews and of Haworth and his school at Birmingham, of Staudinger, Zechmister, and Mark in Germany, and of other workers in the United States has been particularly important in elucidating the structure of these complex bodies.

The structure of the simple sugars and of the disaccharides has now been more or less worked out. The introduction of the six-atom ring formula and the greatly increased use of stereo-chemical methods of exhibiting differences in structure have been important factors in the developments which have been made. More recently, the constitution of the polysaccharides has been engaging much attention and speculation, and notable advances fall to be recorded both by chemical and by *X*-ray methods of investigation. The adoption of Haworth's hexagon formula for glucose has led to new interpretations of the experimental evidence bearing on the constitution of these substances. It has been shown by Haworth and his co-workers that the constitution assigned to cellulose rests ultimately on the constitution assigned to the di-saccharide cellobiose and the mutual linking of β-glucopyranose residues in a chain through positions 1 and 4 of the glucose molecule is the fundamental principle of modern cellulose structure. By purely chemical methods of investigation, they have shown that in some forms the cellulose is a straight chain of limited length containing not more than 100 cellobiose or 200 glucose units.

The question of the size of the cellulose molecule has been attacked by various other methods—by viscosity

measurements of cellulose dissolved in Schweizer's reagent or of the acetate or nitrate in organic media (Staudinger), by study of the cleavage products obtained by enzymes, and by the *X*-ray methods of the Braggs and of Mark. The interesting fact emerges that the results obtained by the *X*-ray investigations of cellulose structure are in such wonderful agreement with the views adopted from chemical methods. Sir William Bragg pointed out in a lecture recently delivered to the Royal Institution that cellulose is the fundamental *molecular combination occurring in vegetable growth* and that it is pre-eminently the molecule of growth in the vegetable world. The cellulose occurring in plants cannot have the same properties in all directions, for growth takes place along definite lines. The fibrous nature of cellulose has long been recognized, as we see by the use which is made of it in spinning threads and ropes which can stand an immense strain in one direction. Bragg's investigations have shown that cellulose is made up of crystals, or crystallites, invisible under the microscope, but capable of detection by *X*-ray methods. These crystallites are partly oriented, having one direction more or less in common, and to this arrangement of the crystallites the peculiar and characteristic properties of cellulose are due. Recent studies by Thiessen have indicated that the structure of the pure cellulose fibre is the same as that of lignified tissue, except that the spacing in the latter is wider to accommodate the lignin. Reference has already been made to the fact that the organic matter of the soil is derived from this lignin complex from which the cellulose has been removed.

It has already been noted that the various stages in the building up of carbohydrates in plants have not yet been satisfactorily explained. At the same time, much work of the highest importance on the composition of the chlorophyll in plants, the active agent in the utilization of the radiant energy from the sun, has been accomplished during the last twenty years. In 1912, Willstätter and his co-workers at Munich showed that chlorophyll as ordinarily obtained is really a mixture of two substances, chlorophyll *a* ($C_{55}H_{72}O_5N_4Mg$) and chlorophyll *b* ($C_{55}H_{70}O_6N_4Mg$). They also investigated the yellow or reddish-brown pigments, carotene ($C_{40}H_{56}$) and xanthophyll ($C_{40}H_{56}O_2$), which accompany the chlorophylls and which are generally referred to as the carotinoids. By a series of brilliantly conceived investigations, Willstätter has been able to throw much light on the structure of these complicated bodies and, in particular, on the relation between the chlorophyll of plants and the hæmoglobin of blood. In this connexion reference must be made to the work of Hans Fischer who has already synthesized hæmin and made great advances towards the synthesis of chlorophyll.

Enzyme action.—It has long been known that enzyme action plays a highly important part in most of the chemical reactions taking place in plants and animals. In addition, the breaking down of complex molecules by the action of enzymes is often employed in investigating the constitution of these substances.

The action of enzymes has been known for over 100 years. Kirchhoff in 1814 had discovered the catalytic action of the glutinous component of wheat meal, and later, in 1833, Payen and Persoz separated an active preparation of this enzyme from malt, the enzyme now known as amylase. While much work of a preliminary kind was carried out in the succeeding years, the results obtained were frequently inconsistent and confusing. This is not to be wondered at when we consider the excessive complexity of these bodies, the difficulties of purifying them and the extremely complicated reactions in which they play a part. It is again Willstätter, whose brilliant work on chlorophyll has just been described, who has been mainly responsible for the great advances which have been made in our knowledge of the enzymes during the past fifteen years. He began by improving the technique of the methods of preparation, introducing quantitative methods of control, and in this way was able to prepare specifically pure enzymes. This has led to a much more accurate knowledge of the specification of enzymes and has cleared up much of the confusion which existed previous to his work. He has investigated the colloidal characteristics of enzymes, the significance of the H-ion concentration of the medium and the action of enzymes as synthetic agents—to mention only a few of the outstanding results. In addition, a rational classification of the enzymes is now possible and much more detailed information about their specific action is available. While the chemical constitution of the enzymes has not yet been solved, there is no doubt that the results of Willstätter and his school have been most stimulating to those engaged in biochemical research and have had an important application to the many industries which make use of enzymes in manufacturing processes.

Vitamins.—A discovery which will always be associated with the name of the distinguished president of the Association this year (Sir Frederick Gowland Hopkins) is the importance in nutrition of the accessory food substances now known as vitamins. As far back as 1881, it was noticed that milk cannot be replaced by an artificial mixture of its chief constituents. In 1905 Pekelharing of the University of Utrecht made the striking claim that there is an unknown but essential substance in milk and other foods which is essential to nutrition. This work was overlooked, and it was not until the publication of Hopkins' work in 1912 that general interest was attracted to the subject. The progress since then in the stndy of these bodies is most striking. One of the most remarkable facts which have resulted from these investigations is the large number of substances of the vitamin type required for the proper nutrition of the higher animals, the nnmber being stated to be at least nine. Ordinarily, five different vitamins are recognized, designated *A*, *B*, *C*, *D*, and *E*. Vitamin-*B* is now subdivided into no less than five substances, commonly referred to as the vitamin-*B* complex.

Vitamin-A.—It is now fairly definitely established that vitamin-*A* is formed by the liver from the pigment carotene ; this pigment occurs in carrots, green leaves, and various vegetables ; it is a hydrocarbon, $C_{40}H_{56}$, which is synthesized in plants by the action of light. Carotene has a deep colour, but vitamin-*A* is colourless. How carotene is converted into vitamin-*A* in the tissues is uncertain. The empirical formula $C_{20}H_{30}O$ (or

$_{20}H_{32}O$) has been suggested, and it appears probable that within the next few years the constitution of this vitamin will be known and then its preparation by synthetic methods will be a possibility.

Vitamin-B.—Much work has already been carried out on the various members of the vitamin-*B* complex, but the position is still obscure and rather confusing. It is still uncertain how many active substances are present and there is still no general agreement as to their properties. B_1 and B_2 are the only two about which definite conclusions are at present available. B_1 has been obtained in the crystalline state and contains both nitrogen and sulphur. The provisional formula $C_{12}H_{17}ON_3S$ has been suggested. It is anticipated that the pure product will be available in the near future. While a considerable amount of work has been carried out as to the chemical nature of B_2, little definite information has yet been obtained.

Vitamin-C.—The striking investigations of Szent-Gyorgyi and of Waugh and King have led to a great advance in our knowledge of this vitamin. What appears to be the essential substance in the vitamin was isolated and found to have the formula $C_6H_8O_6$: it was named hexuronic acid. The preparation of a larger quantity of the material from the juice of Hungarian red pepper by Szent-Gyorgyi has enabled the constitution of the acid to be worked out by Hirst, Cox, and Reynolds at Birmingham. The substance is now named ascorbic acid, and its antiscorbutic properties are so marked that it may well prove to be vitamin-*C* itself.

Vitamin-D is now available as a commercial preparation under the name "Calciferol." It is prepared by the irradiation of ergosterol with ultra-violet light; its formula is $C_{27}H_{42}O$.

The discovery of vitamins has undoubtedly thrown much light on many of the difficult problems of nutrition and disease, and there can be no doubt that, as our knowledge of these substances increases, more and more use will be made of them in feeding. Already some notable advances have been made. The close connexion between the yellow coloured pigment carotene and Vitamin-*A* has just been referred to. Milk and butter produced in the summer months, when the cows are at pasture, have a yellow colour which is associated with the presence of carotene and of vitamin-*A*. On the other hand, butter produced from winter milk, when the cows are stall fed, is much whiter in colour and has a much lower content of carotene and vitamin-*A*. The popular view which associates the yellow colour of milk with "richness" is therefore not at fault, and incidentally, the importance of prohibiting the colouring of butter and cheese should be mentioned. The problem was how to provide food with the necessary carotene or vitamin-*A* content during the winter months. Experiments on the artificial drying of grass carried out at the Agricultural Research Station at Jealotts Hill, Berkshire, have shown that grass can be rapidly dried in a band drier at a temperature of 200° approximately, with scarcely any loss of digestibility or nutritive value and, what is more surprising, with only a small loss of the carotene content. It was also shown that the carotene content and the nitrogen content of pasture herbage were associated, grass of high nitrogen content being rich in carotene, so that by properly balanced manuring the carotene content of the pasture might be maintained at a higher level. A winter feeding experiment with cows was then arranged and the artificially-dried grass was used to replace an equivalent amount of the ordinary food, with the result that the carotene and vitamin-*A* content of the butter was kept up. This effect was not produced by the addition of ordinary green silage. The importance to the public health of being able to produce in winter butter which, in regard to colour and vitamin-*A* content, is equal to the butter produced in summer from grass-fed cows, can hardly be over-estimated.

As regards vitamins generally, the most important problems are the differentiation of the different vitamins and the determination of the vitamin requirements of man and the higher animals. By the time this is done, it appears probable that there will be an abundant supply of pure vitamins to compensate for the deficiencies in the ordinary rations.

While talking of nutrition, the part played by the mineral matter of the food must also be mentioned and the necessity for maintaining a correct ratio between the basic and acidic constituents. Much important work has been carried out in this country in recent years by the Rowett Institute and the Animal Nutrition Research Institute at Cambridge on the mineral content of pastures. In his presidential address at Bristol in 1930 Prof. Du Toit described the far-reaching results of Theiler's work in South Africa on phosphorus deficiency, and referred also to Aston's work on iron deficiency in New Zealand.

Agricultural Development

Sufficient has been said of the scientific advances in recent years to indicate the great importance of their application, when possible, to agricultural industry. At one time it was only too apparent that there existed a long lag between scientific discovery and its application in agricultural research, but this has diminished considerably in recent years; indeed, it may now be said that any new line of work is almost at once turned to account in agricultural investigation. This agricultural work is undertaken mainly at the new agricultural research institutes, although a considerable amount of work is still carried out at the universities and the agricultural colleges.

The development of these research institutes has been one of the most marked advances connected with agricultural science which have taken place in recent years. In Scotland alone, for example, institutes have been established within the last few years for research in animal nutrition, in animal diseases, in animal genetics, in plant breeding, in dairying and in soil science, and the progress in England has been equally great.

How are the results of these investigations brought before the farmer and what is his response to them? How far are they being incorporated into modern agricultural practice? It is one of the functions of the agricultural colleges to be the connecting link between the research institutes and the farmer. Advisory services in connexion with the colleges now cover the whole

country, so that farmers desiring advice have it provided at their own doors and without cost. Mention must also be made of the services of the Ministry of Agriculture and Fisheries, the Department of Agriculture for Scotland, and the Ministry of Agriculture for Northern Ireland, whose various publications, journals, bulletins, etc. contain much valuable information.

As to the reaction of the farmer, one is bound to admit that, owing to the inherent disinclination of the older farmers to listen to new ideas, the response is not what we should desire. At the same time the more intelligent and progressive farmers are fully aware of the value of the advisory work of the colleges and make use of them regularly. The whole attitude of the farmer to the colleges is vastly different from what it was twenty-five or thirty years ago, and the amount of advisory work is increasing year by year. This much must be admitted, however, that there is still room for improvements in agricultural methods and that much of the farming still requires to be raised to the level of the best practice.

We may state, therefore, with confidence that the difficulties of present-day agriculture are not due to the lack of scientific advice available to the farmer: indeed, it is even sometimes alleged that the present-day troubles of agriculture are due to scientific research and to an abnormal increase in production; even the Minister of Agriculture remarked semi-humorously the other day: "Improvements in technique are the great curse of the modern world. Some infernal scientist comes along and shows us how two blades of grass can be made to grow where one was before. Instead of that being the highest praise, it is one of the most damning accusations you can make against any man or any country just now." An amusing piece of invective, but no help to us in our difficulties.

In a paper contributed to this Section last year at York, Mr. E. M. H. Lloyd, the assistant secretary of the Empire Marketing Board, quoted figures to show that the world production of foodstuffs and raw materials though it increased rapidly after the set-back due to the war, had not reached, in 1929, the continuation of the pre-war trend. The statistics suggest that world agricultural production is, in fact, less now than it would have been but for the war. "The agricultural crisis is due to the fall in prices; and this fall of prices is due more to diminution of effective demand through a contraction of consumers' money incomes than to any exceptional increase of supply." It is certain, therefore, that the advances in the application of science to agriculture are not the causes of the prevailing agricultural depression throughout the world, but that these are to be sought for in the absence of satisfactory schemes of collective planning, marketing, stability in the value of money and the maintenance of better equilibrium between prices, wages, and debts, to quote again from Mr. Lloyd.

Whatever opinion may be held as to over or under-production of agricultural produce in the world as a whole, this much at any rate is clear: that an increased production of home-grown food is of paramount importance to our own country.

There are two main reasons why this is so urgent. We have to remember that in the industrial changes which have taken place since the war many of our industries have either disappeared or have been so reduced in amount that there has been a serious displacement of labour. So far as one can see, there is no prospect of these industries recovering their former size in this country, and, while new industries may be introduced, there is a grave fear that the displacement of many workers from their previous occupations is permanent. No better way of using this displaced labour can be imagined than to employ it on the land to increase our home agricultural production. It is unnecessary to point out or minimize the obstacles to so profound a change—the disinclination of an urban population to move to the country, the problems of housing and wages, and the necessity of obtaining a remunerative price for the food produced are only some of the more obvious difficulties involved.

The second reason is equally important, and that is to supply the consumer with as large a proportion as possible of fresh food which has not been subjected to chilling or freezing or to any of the chemical manipulations or treatment which are much too common nowadays. The deleterious effects of some of these processes on the general quality of food is now well appreciated, and it is certain that, no matter how carefully these methods are carried out and controlled, the resulting product is not as good as the fresh material. The aim of the home producer should be, therefore, to produce the type of food in largest quantity where this quality of freshness is of the highest importance—*e.g.* meat, milk, butter, eggs, poultry, and market-garden produce and fruit. In this way he can best meet the menace of overseas competition. At the same time much work will require to be done to educate the consumer to appreciate the superior value of fresh home-grown food as against that which has been chilled or preserved. It is quite certain that the consumer will not purchase home-grown produce for sentimental reasons; he will have to be convinced that the quality is better and that he is getting equally good value for his money. It will be necessary in this connexion for the home producer to study the public taste a little more carefully perhaps than he has done in the past.

The modern farmer must now choose between two courses. He may either adhere to traditional systems under which his products have to meet those of overseas competitors who possess dominant advantages in the production of most of their crops, or, on the other hand, he may alter his system to meet the new conditions and produce those commodities which will command an unassailable position in the home market. This alteration in the system of farming will mean many important changes; more concentrated foods must be grown, *e.g.*, beans and peas, and less concentrated foods imported. In this connexion the highly nutritive quality of young grass and the methods for its utilization should receive more attention; the growing of hay on a quality basis and the adequate use of silage should also be mentioned.

Another problem to which sufficient attention is not being paid at present is the use of the poorer quality of land, such, for example, as we find in Scotland at elevations of 600 ft. and over. Much of this, under proper methods of management, could produce a larger number

tore cattle, milk and milk products, and poultry ı it does at present. In more favourable times the ibility even of further land reclamation should not verlooked. It may seem futile at a time when there ch difficulty in getting any adequate return from our land to suggest that further land should be remed: the present conditions, however, will not, hope, be permanent, and we have to consider what be possible in more normal times. The spectacle arge areas of land suitable for reclamation and close our great industrial centres reflects little credit on agricultural policy of the past generation or two. many of these areas there are abundant supplies of our near at hand, and the difficulties of housing and nsport would be reduced to a minimum. It is not gested that at present such reclamation would be nomic, but as a means of using unemployed labour it uld at least have the merit of leaving something tanle as the result. In an article contributed to *The nes* last November Sir Daniel Hall gives an interesting ount of the enormous reclamation and land drainage rk which has been carried out in Italy during the past ı years, and points out that the agriculturally minded n must regard it as the biggest bit of constructive rk since the war ended. In conclusion he says: A great work. But what of the cost? As yet, it is possible to judge of the finance, for who shall say what ıd is worth or is going to be worth? But the Italian ate is said to have expended £31,000,000 gold in the t ten years on 'Bonifica' against which it is claimed at over a million acres have been or are being reimed. The severely economic English view would be at, since land is going out of cultivation, it is waste of oney to make more. But in Italy men do still live the land; the money has been spent in Italy and most wholly on labour, and there is something real and sting to show for the expenditure. It is a return to e high Roman way, to the courage that drove the first ads and built the bridges through Barbarian Europe."

The importance of agriculture, not merely as a means producing additional home-grown food but as an dustry of fundamental social value, is now being alized by all sections of the community. With the od offices of statesmen, scientists, economists, and hers interested, and with the goodwill of the people large, it is not too much to hope that the British rmer will choose wisely, and that the character and ergy which have distinguished him for generations ill enable him to secure once more for our British griculture that prosperity which is vital to the welfare f our nation.

ADMIUM, THALLIUM, INDIUM, AND GALLIUM S BY-PRODUCTS OF THE LITHOPONE INDUSTRY

By Dr. W. N. HIRSCHEL

When we study the history of the discovery of these lements we see that cadmium, indium, and gallium re often present in zinc ores. Thallium was discovered the lead slimes of the sulphuric acid chamber, but fterwards its presence was demonstrated repeatedly in aterials containing zinc.

Now the manufacture of lithopone uses large quantities f materials containing zinc, which are accompanied by the above-named elements, for 20 kg. of zinc are required for manufacturing 100 kg. of lithopone.

The zinc and the accompanying metals contained in the raw materials are dissolved as sulphates or as chlorides. The zinc solution thus obtained must be purified from all the accompanying metals, because all of them give coloured sulphides which would spoil the whiteness of the lithopone. That purification is effected by treating the solutions with zinc fume (blue powder), precipitating in this way all the heavy metals and the above-mentioned elements. It is therefore natural to use these precipitates in order to obtain these rare elements.

In purifying the zinc solution with zinc fume an excess of the latter must be used to throw down the last traces of these metals. Proceeding in this way the metals are precipitated as metals whilst the zinc fume itself is dissolved. At the same time an undesired reaction takes place which consumes zinc, dust forming the combination $3ZnO{\cdot}ZnSO_4{\cdot}8aq.$[1] which floats in the solution as a silky glossy precipitate near the precipitated metals and the excess of zinc fume.

The solution is filtered and the residue, named cadmium residue, may be utilized to obtain the four metals separately. It consists principally of the three basic sulphates of the metals mentioned above, of the still unused metallic fume, and of the heavy metals, which accompany the zinc. As far as quantity is concerned, lead, copper, cadmium, and nickel are preponderant as a rule, whereas thallium, indium, and gallium are always to be found in small percentages.

Cadmium.—In order to extract the cadmium, the residue is stirred with water or with zinc solution in a vat and sulphuric acid is gradually added. In the first place the basic zinc sulphate is dissolved, then the acid begins to attack the metallic zinc fume liberating hydrogen. Because this hydrogen contains also arsenic the greatest care is necessary; the vat must be provided with a tight lid and a chimney. As long as metallic zinc dust is present near the precipitated metals the latter are not dissolved. As it is desired to dissolve only the zinc fume, the acid must be carefully introduced and one has to examine repeatedly to see if a filtered sample of the solution does not give a yellow precipitate when treated with sulphuretted hydrogen. If sufficient sulphuric acid has been added a small yellow precipitate of cadmium sulphide appears at the test. If by mistake too much cadmium has been dissolved, this must be reprecipitated again by zinc fume or by a fresh quantity of residue. The content of the vat is now filtered and the residue completely washed in the press and dried. It contains only a little zinc and 10% to 30% of cadmium. The cadmium contained in it comes not only from the zinc materials but also from the zinc fume used, which very often proves to contain cadmium. Accordingly carbonates and oxides of zinc obtained from zinc fume, which has been used for reduction, give a cadmium residue with a high percentage of cadmium.

The cadmium residue obtained in this way may be distilled directly. If not too much thallium (see below) is present in it, it yields a cadmium metal of high purity (99·9%) by distilling only once. I constructed for this purpose furnaces (Industries Chimiques de Wilsele, Belgium, and Dr. Marquart, Beuel am Rhein)

[1] *Chem. Ztg.* 1927, p. 590.

which bear a strong likeness to the Silesian zinc smelting furnace; the furnace is provided with four iron retorts. As cadmium distils at 778° C., zinc at 920° C. and cast iron melts at about 1050° C., it is necessary to keep the temperature of the furnace between 800° and 900° C., which can be done without difficulty by means of a pyrometer.

Thallium.—Thallium may be precipitated in very rare cases directly from the zinc solution. Once at Triebes (Germany) I employed flue dust of a Silesian zinc smeltery for the manufacture of lithopone. This flue dust, which is formed in roasting blende, consists chiefly of zinc sulphate. In that case it contained 0·6% of thallium. The flue dust was extracted with dilute sulphuric acid in the ordinary course of manufacture and the solution precipitated directly by hydrochloric acid. By this method thallous chloride is thrown down, the solubility of which is small in the presence of an excess of chlorine ions. After having been filtered and washed, the thallous chloride was converted into sulphate by means of concentrated sulphuric acid and precipitated again with hydrochloric acid. The pure chloride obtained was converted again into sulphate and dissolved; the solution was electrolysed between carbon electrodes. The resulting spongy thallium was melted down in crucibles in an atmosphere of hydrogen. The chloride or sulphate of thallium may also be precipitated directly by metallic zinc, but one runs the risk of contaminating the thallium by the zinc and its impurities.

The cadmium residue often contains not inconsiderable quantities of thallium, which, on the distillation of the cadmium, partly volatilize with the cadmium and render it impure. It is easy to see whether the thallium must be eliminated from the residue by the following test: sulphuric acid of about 12 Bé. is neutralized with the residue and filtered; to the filtrate concentrated hydrochloric acid is added; a white precipitate of thallous chloride shows the presence of a considerable quantity of thallium in the residue. In this case if one wishes to separate the thallium from the residue one might proceed on a technical scale, following the method of the test. In that case the solution of the cadmium sulphate, which has been filtered from the thallous chloride, must be precipitated again with metallic zinc.

The precipitate which is formed by adding hydrochloric acid to a solution of cadmium, containing thallium, is in fact not ThCl but the double chloride, $CdCl_2ThCl$. This double salt is split up by washing it with water.

Indium and gallium.—Indium is always found in cadmium residues; gallium very often. I found in the residues at Fürfurt on the Lahn 0·15% of indium when zinc purple ore (from Meggen) was used for the manufacture of lithopone. One can easily test whether the residue contains indium and gallium by dissolving the residue with sulphuric acid and precipitating the filtrate fractionally with soda solution. The first fractions contain the two rare metals. A pocket spectroscope, with wave-length scale and a fulgurator, is used to detect them. The indium lines 4511 and 4101, as well as the gallium lines 4172 and 4033, appear if traces of these elements are present.

SOCIETY OF CHEMICAL INDUSTRY

OFFICIAL NOTICES

Plastics Exhibition. As a result of applications from the Trade Association and others interested in developments of plastics, the authorities have decided to keep open the Exhibition which is staged at the Science Museum, South Kensington, for a further period.

Annual Chemical Dinner. The date of the dinner this year is now finally fixed for Tuesday, November 28. In previous years this popular event has taken place in the Connaught Rooms, but it has not been found possible to secure accommodation there on a date that would not conflict with the interests of some of the participating societies.

The Wharncliffe Rooms and the Winter Garden of the Great Central Hotel, Marylebone, have been booked, and in view of the increased capacity there should be less fear of late applications being refused for lack of accommodation. The dinner will be followed by a dance, as in recent years, and the price of the ticket is again fixed at 12s. 6d. Members of any of the societies which have a prominent interest in chemistry may participate. The date should be reserved now.

OBITUARY

JOHN BRYSON ORR

By the death of Mr. J. B. Orr the Society has lost one of its original members, whilst the chemical industry is the poorer by one who could claim to have taken an important part in its history. Orr's name is known to every one engaged in the paint and varnish industry, in other countries as much as in England.

Orr was born in Blantyre, Lanarkshire, in 1840, and his connexion with the oil and colour industry, which was to last for so many years, began with his apprenticeship to the firm of Lewis, McLellan & Co. in Glasgow. In this city he studied chemistry, amongst other subjects, at the Andersonian University. At the age of 21 he began experimenting with a mixed zinc and barium pigment and actually produced the pigment in bulk in 1865. By 1872 he had returned to Glasgow, where he set up his first factory for the manufacture of lithopone, taking out patents in 1874. These works were burnt out a few years later, and he came south to start in 1880 the Silicate Paint Co. in London, where he manufactured not only lithopone, sold under the name of "Charlton White," but also the first washable distemper, known as "Duresco." In the meantime the production of lithopone, or Orr's "Weiss," had been begun in Germany. From these small beginnings the lithopone industry was built up in America, this country, and the Continent, until the production to-day is in the neighbourhood of half a million tons a year. In 1896 Orr's Zinc White Works was started in Widnes, and is still busily manufacturing, having been acquired by the Imperial Smelting Corporation in 1930.

More than 300 employees attended the funeral, held on September 30. Others present included his son, Mr. Donald Orr, Mr. J. S. Towers, secretary of the Liverpool Section, representing the Society, Mr. J.

rguson (J. Ferguson & Son, Ltd.), Mr. G. Ferguson (Cornbrook Chemical Co.), Mr. L. B. Robinson (Imperial Smelting Corporation), and many others.

CORRESPONDENCE

METRIC UNITS OF VOLUME

SIR,—It is the Briton's proud privilege to call a thing by whatever name he chooses, without reference either to rhyme or to reason. If, therefore, what he calls a cubic centimetre has no reference to either centimetres or cubes, but is really the thousandth part of the volume of a certain weight of water, who need be surprised and who is going to stop him anyway? The more one accuses him of his inconsistency, the more likely is he to pull out his plumbago pencil, adjust his synthetic-resin-rimmed spectacles, and deliberately write c.c. when he really means ml.

I am, Sir, etc.,

Oct. 1, 1933 ANON.

SIR,—Personally I should be very sorry to see the "c.c." dropped, considering its great employment and many purposes served apart from that of "ml."

I am,
Sir, etc.,
C. T. KINGZETT

Weybridge
Oct. 1, 1933

JARGON IN SCIENCE

SIR,—Your editorial on "Jargon in Science" is welcome, as it expresses the views of those "human" chemists who, in the course of their daily life, mix with the world in general. It should form the early morning reading of every young chemist until its lesson is learnt.

It is exceptional to meet a chemist who is even able to present his case in writing when making an application for a position, but to meet a chemist—or any scientist for that matter—who can really write an intelligible report in plain English is a rare occasion. Why is it so? In my opinion it arises from his distorted mental outlook through constant association with others similarly afflicted. He is conceited in thinking he is "the salt of the earth" and therefore the world should learn to understand him and not he to understand the world. Chemists as a body are only half human (although some of them are even attaining respectability in dress), and until they mix with the world and learn its ways, their pitiful cries for recognition will continue to be unheard.

I am, Sir, etc.,
W. SINGLETON

Wembley, Middlesex
Sept. 26, 1933

PERSONAL AND OTHER ITEMS

We deeply regret to announce the death on September 28 at the age of 87 of Mr. T. W. Stuart, one of the original members of the Society. Mr. Stuart was in some measure responsible for the formation of the Society, for it is recorded by Mr. John Hargreaves that it was after attending a meeting of the Tyne Chemical Society at Mr. Stuart's invitation, that he convened the meeting of chemists and managers at Widnes which led eventually to the formation of the Society of Chemical Industry. Mr. Stuart was educated at Newcastle and Edinburgh University. His first appointment was that of chemist in the works of C. Allhusen & Sons. Later he went to the Felling Coal & Chemical Co. and was then appointed manager of the Hebburn-on-Tyne works of Messrs. C. Tennant & Co. On the formation of the United Alkali Co. he became district manager of fourteen works, and from 1905 to 1926 acted as general technical manager of the company's works in Scotland. He became a director of the United Alkali Co. on his retirement in 1926. In the North of England he was considered an expert on problems connected with labour, and had conducted many arbitrations, being held in the highest esteem by both Trades Union officials and men. At his funeral on October 2 the Society was represented by Mr. Gabriel Jones of the Liverpool Section, of which Mr. Stuart was a member.

Mr. S. J. Astbury, M.A., has been appointed secretary of the Institution of Petroleum Technologists in succession to Commander R. E. Stoke-Rees, R.N. Mr. Astbury has been secretary of the Staffordshire Iron and Steel Institute for the last five years.

Dr. H. W. Strong, M.Sc., has returned to Australia after having spent seven years in England, during which time he studied at the Imperial College of Science, and later joined the staff of Imperial Chemical Industries, Ltd. working on research and the development of new processes. He will now join the staff of Imperial Chemical Industries of Australia and New Zealand, Ltd., in Sydney.

We regret to learn of the death recently in Brisbane of Mr. J. C. Brunnich, for many years Government agricultural chemist in Brisbane. He was an advisor to the Government on many subjects connected with agriculture, and did much valuable work in connexion with inspection and reporting on the operation of sugar mills.

Mr. H. F. E. Hulton is to give the sixteenth Streatfeild Memorial Lecture at the Institute of Chemistry on Friday, November 17, on the subject "Beer."

British Plastics Industry and Pollopas

An important development in the plastics industry is marked by the announcement that British Cyanides Co., Ltd., the well-known manufacturers of Beatl plastics, has acquired the Pollopas patents controlling the manufacture of resins and moulding powders of the urea-formaldehyde type for Great Britain, the British Empire (with the exception of Canada) and certain Continental countries. The company has also entered into an arrangement whereby a full exchange of patents and information will be made with other licensees of Pollopas patents in Europe, *i.e.*, the I.G. Group in Germany and Etablissements Kuhlmann in France.

These arrangements have been made with the objects of consolidating the patent position and pooling existing knowledge concerning urea type plastics in order to improve their quality for the benefit of the industry.

Mr J. C. Vredenburg, managing director of Pollopas, Ltd., has joined the Board of British Cyanides Co., Ltd.

British Standards Institution Annual Report

The British Standards Institution has issued its half-yearly handbook which includes the report presented at the last annual general meeting as well as the indexed list of current British Standard Specifications. The report on the activities of the three Divisions, Engineering, Building, and Chemical, provides interesting reading and shows the enormous amount of valuable work voluntarily carried out by the Institution's 600 technical committees.

The Chemical Division has 16 technical committees and 14 sub-committees, and the report contains a good deal of information concerning work in progress. The specification No. 334 for chemical lead is being revised, and will include lead to which alloys have been added. Specifications which are in course of preparation, and which will be welcomed, deal with scientific glassware, vegetable oils, solvents, and nickel anodes and chemicals used in electroplating. In the Chemical Engineering Section, subjects which are being considered for standardization include containers for heavy acids, corrosives, and solvents; stoneware; and welded containers for liquefiable gases.

The report contains a number index to the specifications issued to date, and a subject index, andit should be found useful in all drawing offices and purchasing departments of public authorities and firms engaged in the engineering, chemical, and allied industries. Copies of this useful publication (C.D. 800) can be obtained from the British Standards Institution, 28, Victoria Street, London, S.W.1, price 1s. 2d. post free.

British Standard Nomenclature for Welding

The British Standards Institution has just issued a new British Standard (No. 499—1933), which will be of special interest to those concerned with the manufacture of chemical and other plant, in which the rapid development, during the last few years, of welding, especially fusion welding, has introduced a technique of its own. With this technique has come a new vocabulary. The definition of the precise meaning of the terms employed has become a matter of importance, and the British Standard Nomenclature, Definitions and Symbols for Welding and Cutting will therefore be welcomed.

Two distinct and definite objects have been kept in view in preparing this Standard. One, to establish agreement as to the exact meaning to be attached to terms that have become associated with welding practice, and the other, to draw up a standard system by means of which the form and details of welded joints can be readily indicated on engineering drawings.

The Standard is in five sections, giving definitions of (*a*) general terms; (*b*) methods and joints relating to forge welding; (*c*) methods and joints of pressure welding; (*d*) methods and joints of fusion welding; (*e*) terms relating to welding and cutting equipment.

To achieve the second object, namely, the standardization of a system for indication of welds in engineering drawings, the Standard puts forward a system in which a capital letter is used to indicate the general form of joint, such as "B" and "T" for a butt joint and tee joint respectively, and a combination of numbers and suffix letters is appended to indicate the particular form of weld, and there is also a statement of the dimensions to be given. Details of the working of the scheme are given in full, together with an explanatory chart; an illustration of each form of fusion welded joint is included and a weld symbol given to it.

Copies of the new Standard can be obtained from the Publications Department, British Standards Institution, 28, Victoria Street, London, S.W.1, price 2s. 3d., post free.

University of Manchester

An announcement by Manchester University states that a fund raised by Manchester citizens to offer a temporary home to German scholars, dismissed because of their Jewish origin or political "unreliability," is being administered by the University, and is being used to found a number of research fellowships. The Fellows now appointed include Dr. Rudolf Peierls (Leipzig) in the Department of Physics and Dr. Walther Deutsch (Düsseldorf) in the Department of Physiology. The appointments are in no case for more than two years, and it is expected that the Fellows will assist in the teaching of advanced students, although they are under no obligation to do so.

American Chemical Society Convention

More than 3000 persons, a record for the meeting, attended the annual convention of the American Chemical Society recently held in Chicago. During the meeting Dr. Willstätter was presented with the Willard Gibbs Medal by Dr. Julius Stieglitz of the University of Chicago. The visitors to the convention included Dr. A. E. Dunstan, who was a joint author of a paper on "The Thermal Decomposition of Gaseous Hydrocarbons," given before the Division of Petroleum Chemistry. Dr. Dunstan also spoke at the dinner given in honour of Dr. Willstätter.

Imperial Institute of Mycology and Entomology

The administrative and financial control of the Imperial Institute of Entomology and the Imperial Mycological Institute is shortly to be transferred to the Executive Council of the Imperial Agricultural Bureau. Lord Buxton, who has been chairman of the committees of both institutes for several years, has received a letter from the Prime Minister, Mr. J. Ramsay MacDonald, thanking him and the committee members for their valuable services.

New Manvers Main Coke Ovens

The erection of 30 coke ovens, the first part of a scheme that will ultimately include 45 ovens, has recently been completed at the Manvers Main Collieries, near Barnsley. The ovens, which have been supplied by Simon-Carves, Ltd., are of the twin-flue underjet type; equipment includes coke-screening plant, gas condensers, an electrical de-tarrer, three ammonia and three benzole scrubbers, and a plant capable of producing 10,000 gal. of motor spirit. The doors of the ovens are of the Wolff self-sealing type which do away with clay-luting.

ne Zinc Cartel

The members of the International Zinc Cartel met at ussels on October 1 and decided to renew the agreeent, with some modifications affecting the method of ving fines for production in excess of quotas, the atter on which the Belgian members of the cartel d been dissatisfied.

orld Production of Zinc

Figures issued by the American Bureau of Metal tistics, quoted in *Die Chemische Industrie*, give the rld production of zinc for the first half of 1933 as 800 tons, compared with 456,700 t. for the corrending period last year. Production in individual untries was as follows: United States 129,200 t., igium 66,800 t., Australia 49,900 t., Poland 700 t., Canada 40,600 t., France 32,000 t., and rmany 25,900 t.

anadian Mining

Production of soaps, cleaning preparations, and shing compounds in Canada last year reached a tal value of $17,047,452, a decline of about one million llars. The total capital investment was $15,322,398, nployees numbering 1699.

The International Nickel Co. of Canada, Ltd., has own in a third blast furnace at Coniston, Ontario, inging the smelter operations at that point up to out 65% capacity. The market for nickel, which s shown a steady increase since last autumn, is being ll maintained, and sales are keeping up to an encourag degree.

According to the *Financial Times* (Montreal), an nouncement has been issued at Ottawa by the Minister Finance, intimating that the Dominion Government decided to permit the importation into Canada from United States of gold ore, gold concentrates, gold ecipitates and unretorted amalgam for treatment at nadian smelters. One of the effects of the decision ll be to permit the Royal Canadian Mint at Ottawa extend its refining facilities to United States gold. nelting will be carried out in northern Ontario, and at ail, B.C., but gold will be refined to the purer state at e Ottawa Mint.

Chemical Engineering Equipment Organization in U.S.A.

Representatives of 35 American firms engaged in the emical engineering industry recently met in New York d formed the Chemical Engineering Equipment Instite. The objects of the Institute are to promote the erest of manufacturers, designers, and distributors chemical engineering equipment, and to improve nditions in the industry. Its immediate concern is to ke advantage of the provisions of the National Indusal Recovery Act in America. A temporary governing dy has been formed under the presidency of Mr. H. D. les of the Buffalo Foundry & Machine Co.

port Trade of British India

Although the total imports into India during the st quarter of the fiscal year, April—June, fell from . 37,00,00,000 to Rs. 28,00,00,000 compared with same quarter last year, the percentage of the reduced de obtained by the United Kingdom rose from 2% to 42%, showing for the first time the effect of preferential rates of duty enjoyed by English goods. Notable increases of imports from England were recorded in yellow metal sheets, wrought copper, hardware, motor-cars and tyres, wrought-steel tubes, and lubricating oils. Imports from Continental countries generally declined, but Japanese competition has become more severe in a wide range of articles.

The Chemical Industry in Italy

The production of synthetic resins in Italy during 1932 amounted to about 1000 tons, according to the journal of the *Union des Industries Chimiques*. In spite of a falling off in demand, with also increased competition from Japan, celluloid is continuing to be exported in satisfactory quantities to England, Canada, and Australia.

Production of dyestuffs amounted to nearly 6000 tons and intermediate products to 6600 tons, both totals being slightly higher than last year. Imports of dyestuffs have increased and exports are appreciably greater.

There has been a notable falling off in Italy of the demand for pharmaceutical preparations, especially the more expensive articles. In the case of proprietary medicines the production has decreased by 30%.

B.S. Specification for Fuel Creosote

With the increasing application of oil-firing a new B.S. Specification (No. 503—1933) for Creosote for Fuel in Furnaces is to be welcomed. The limits specified include a specific gravity not exceeding 1·07 at 38° C., a gross calorific value of at least 16,000 B.Th.U. per lb., a flash point not lower than 150° F., and complete fluidity on being warmed to 38° F. with stirring. The appendices detail the methods by which specific gravity, viscosity, water, insoluble matter, flash point, ash, and calorific value are to be determined, and a description of the Dean and Stark apparatus is given. The specification can be obtained from the Publications Department, British Standards Institution, 28, Victoria Street, London, S.W.1, price 2s. 2d., post free.

Production of Superphosphate and Copper Sulphate in Italy

In the first 6 months of 1933, 87 factories in Italy produced 499,407 tons of superphosphate, compared with 307,765 t. for the first half of 1932. The peak output was in 1930, when a figure of 1,388,100 t. was reached in the year. Copper sulphate production has risen from 72,876 t. for the first half of 1932 to 78,740 t. for the same period in this year (*Die Chemische Industrie*).

COMPANY NEWS

MUREX, LTD.

The accounts of the company show a net profit for the year ended June 30, 1933, of £55,411, compared with £54,255 last year. Final dividend of 20% is recommended, making 35% for the year. The company's business has continued to expand during the year, involving heavy capital expenditure and the carrying of larger stocks by the company and its subsidiary, Murex Welding Processes, Ltd. The company is also contemplating further development, and the ordinary capital is therefore being increased from £200,000 to £225,000 by the creation of 50,000 shares of 10s. each. These shares, together with balance of existing unissued capital, bringing the total to 76,966, are being offered to shareholders registered on October 3, 1933.

BURT, BOULTON & HAYWOOD, LTD.

The directors of the company, tar distillers, chemical manufacturers, etc. recommend a dividend of 3½% on the ordinary shares for the year ended June 30, 1933, as against 8% for the year 1931—32.

TURNER & NEWALL, LTD.

It is announced that, as from October 1, 1933, the company is consolidating its subsidiary companies concerned with the manufacture of asbestos-cement and asbestos-electrical insulations into one organization which will be a branch of the parent company and will trade as Turners Asbestos Cement Co., with headquarters at Trafford Park, Manchester, and branch offices at London, Glasgow, Newcastle, Birmingham, and Bristol. The organization will include Turners Asbestos Cement Works, Bell's Poilite Works, and British Fibro Works, at Manchester, Widnes, and Erith, Kent, respectively; and the four previously subsidiary companies. Asbestos Cement Building Products, Ltd., Turners Asbestos Cement, Ltd., Bell's Poilite & Everite Co., Ltd., and British Fibrocement Works, Ltd. will go into liquidation. The reorganization has already been effected to a large extent, and the change is now one of name only, so that customers are in no way affected.

ERINOID, LTD.

The directors of the company, which manufactures "*Erinoid*" plastics, have declared a dividend of 11¼% less tax for the year ended July 31, 1933. The distribution last year was 10%, and in the previous year 5%.

STAVELEY COAL AND IRON CO., LTD.

The company reports a profit for the year ended June 30, 1933, of £404,819, an increase of £32,527 compared with the previous year's profit. Depreciation absorbs £167,484; with £107,156 the total available is £337,824. A sum of £50,000 is again placed to reserve, and £10,000 is allocated to further depreciation of workmen's houses; a final dividend of 2½% is recommended, free of tax, bringing the total to 5%, the same as last year, and £108,556 is carried forward.

During the year trading is stated to have been poor again, and collieries have been working only little more than half time, whilst only 3 of the 4 furnaces have been in operation. The company is erecting a plant for coke-screening and conveying and ore-crushing and handling, by means of which the production of pig-iron will be made cheaper. The erection of this plant is almost complete.

TAYLORS (CASH CHEMISTS), LONDON, LTD.

The directors of the company have declared a further dividend of 1½% actual in respect of arrears of dividend on the 7½% cumulative preferred ordinary shares up to September 30, 1933. Apart from a payment of 1½% on March 31, 1933, the dividend is in arrears from March 31, 1931. The directors intend to submit a scheme for reorganization of the capital as soon as the accounts for the year ended September 30 have been prepared. The issued capital is £826,500 of £2,000,000 authorized, and £750,000 of the issued capital is in 7½% cumulative preferred ordinary shares.

MARKET REPORT

This Market Report is compiled from special information received from the manufacturers concerned.

Unless otherwise stated, the prices quoted below cover fair quantities net and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Acid, Acetic, 40% tech.—£20 5s. per ton d/d address U.K. in casks.

Acid, Chromic.—10½d. per lb., less 2½% d/d U.K.

Acid, Hydrochloric.—Spot, 4s.—6s. per carboy d/d according to purity, strength, and locality.

Acid, Nitric 80° Tw.—Spot, £18—£25 per ton makers' works, according to district and quality.

Acid, Sulphuric.—Average National prices f.o.r. makers' works, with slight variations up and down owing to local considerations: 140° Tw., Crude Acid, 60s. per ton. 168° Tw., Arsenical, £5 10s. per ton. 168° Tw., Non-arsenical, £6 15s. per ton.

Ammonia (Anhydrous).—Spot, 10d. per lb. d/d in cylinders.

Ammonium Bichromate.—8d. per lb., d/d U.K.

Bisulphite of Lime.—£6 10s. per ton, f.o.r. London, packages free.

Bleaching Powder, 35/37%.—Spot, £8 15s. per ton d/d station in casks, special terms for contracts.

Borax, Commercial.—Granulated, £15 10s. per ton. Powder, £17 per ton. (For 1-ton lots and upwards packed in 1-cwt. bags, carriage paid any station in Great Britain.)

Calcium Chloride, Solid, 70/75%.—Spot, £5 5s. per ton d/d station in drums.

Chrometan.—Crystals, 3¼d. per lb.; Liquor, £19 10s. per ton d/d U.K.

Chromium Oxide.—10½d. per lb., according to quantity d/d U.K.

Methylated Spirits, 61 O.P.—Industrial, 1s. 8d.—2s. 3d. per gal.; Pyridinized Industrial, 1s. 10d.—2s. 5d. per gal.; Mineralized, 2s. 9d.—3s. 3d. per gal. 64 O.P. 1d. extra in all cases. Prices according to quantity.

Nickel Sulphate.—£49 per ton d/d.

Nickel Ammon. Sulphate.—£49 per ton d/d.

Potash, Caustic.—£30—£33 per ton. Potass. Bichromate crystals and granular.—5d. per lb., net d/d U.K., for spot. Discount according to quantity. Ground, 5⅝d. per lb.

Potassium Chromate.—6½d. per lb., d/d U.K.

Sal ammoniac, Firsts lump.—Spot, £42 17s. 6d. per ton d/d address in barrels. Chloride of Ammonia.—£37—£45 per ton, carr. paid.

Salt Cake, unground.—Spot, £3 15s. per ton d/d station in bulk.

Soda Ash, 58° E.—Spot, £5 17s. 6d. per ton, f.o.r. in bags, special terms for contracts.

Soda, Caustic, solid 76/77° E.—Spot, £14 5s. per ton d/d station in drums, special terms for contracts.

Soda crystals.—Spot, £5—£5 5s. per ton d/d station or ex depôt in 2-cwt. bags.

Sod. Acetate 97/98%.—£21 per ton. Sod. Bicarbonate (refined).—Spot, £10 10s. per ton d/d station in bags. Sod. Bichromate Crystals, Cake, and Powder —4d. per lb., net d/d U.K., discount according to quantity. Anhydrous 5d. per lb. Sod. Bisulphite Powder 60/62%.—£16 10s. per ton delivered, 1-cwt. iron drums for home trade.

Sodium Chromate.—3⅞d. per lb., d/d U.K.

Sod. Phosphate.—£12 10s. per ton, f.o.r. London, casks free. Sod. Silicate 140° Tw.—Spot, £8 5s. per ton d/d station, returnable drums. Sod. Sulphate (Glauber's Salt).—Spot, £4 2s. 6d. per ton d/d. Sod. Sulphide solid, 60/62%.—Spot, £10 15s. per ton, d/d in drums. Crystals, 30/32%.—Spot, £8 per ton, d/d in casks. Sod. Sulphite, Pea Cryst.—Spot, £13 10s. per ton, d/d station in kegs; Commercial.—Spot, £9 10s. per ton, d/d station in bags.

RUBBER CHEMICALS

Antimony Sulphide.—Golden.—6½d.—1s. 1½d. per lb., according to quality. Crimson.—1s. 3d.—1s. 5d. per lb., according to quality.

Arsenic Sulphide, Yellow.—1s. 5d.—1s. 7d. per lb.

Barytes.—£7 10s.—£9 per ton, according to quality.

Cadmium Sulphide.—2s. 8d.—3s. per lb.

Carbon Bisulphide.—£30—£32 per ton, according to quantity, drums extra.

Carbon Black.—3d.—4½d. per lb., ex wharf.

Carbon Tetrachloride.—£41—£46 per ton, according to quantity, drums extra.

Chromium Oxide, Green.—1s. 2d. per lb.

Diphenylguanidine.—2s. 2d. per lb.

India-rubber Substitutes, White.—4½d.—4¾d. per lb. Dark.—3½d.—4¼d. per lb.

Lamp Black.—£45—£48 per ton.

Lead Hyposulphite.—9d. per lb.

Lithopone, 30%.—£17 10s.—£18 per ton.

Mineral Rubber "Rupron."—£18 10s. per ton.

Piperidine Rubber Accelerators.—P.P.D.—10s. 6d.—11s. 6d. per lb.; Z.P.D.—7s.—7s. 6d. per lb.; L.P.D.—6s. 6d.—7s. per lb.; P.T.D.—9s. 8d.—10s. 4d. per lb.; C.P.D.—8s. 3d.—8s. 10d. per lb.; S.P.D.—8s. 1d.—8s. 7d. per lb.; P.T.M.—11s. 6d.—12s. 6d. per lb.

Sulphur.—£11 10s. per ton. Sulphur Precip. B.P.—£55—£60 per ton. Sulphur Precip. Comm.—£50—£55 per ton.

Sulphur Chloride.—5d.—7d. per lb., according to quantity.

Vermilion, pale or deep.—4s. 3d.—4s. 5d. per lb.

Zinc Sulphide.—11d.—1s. per lb., according to quality.

WOOD DISTILLATION PRODUCTS

Acetate of Lime.—Brown, £8 15s.—£9 per ton. Grey, £14—£16 per ton. Liquor, Brown, 30° Tw., 6d. per gal.

Amyl Acetate, technical.—95s.—110s. per cwt.

Charcoal.—£6—£11 per ton, according to grade and locality.

Methyl Acetone, 40/50%.—£50—£52 per ton.

Wood Naphtha.—Miscible, 3s.—4s. per gal. Solvent, 3s. 9d.—4s. 9d. per gal.

Wood Tar.—£2 10s.—£6 per ton.

Wood Creosote.—6d.—2s. per gal.

TAR PRODUCTS

Acid Carbolic.—Crystals.—9d.—10d. per lb. Crude 60's, 2s. 5d.—2s. 6d. per gal.

Acid Cresylic, 99/100.—1s. 6d.—1s. 8d. per gal. Refined, 1s. 8d.—1s. 9d. per gal. Pale, 98%, 1s. 4d.—1s. 5d. per gal. 95%, 11d.—11½d. per gal. Dark, 10d. per gal.

Anthracene Oil, Strained, 4½d. per gal.

Benzole.—Prices at works: Crude, 9d.—9½d. per gal.; Standard motor, 1s. 4d.—1s. 4½d. per gal.; 90%, 1s. 5d.—1s. 6d. per gal.; Pure, 1s. 7½d.—1s. 8d. per gal.

Creosote.—B.S.I. specification, 3d. per gal., d/d. Heavy—4d. per gal.

Naphtha.—Solvent, 90/160, 1s. 4d.—1s. 5d. per gal. Solvent, 95/160, 1s. 8d. per gal. Solvent 90/190, 11d.—1s. 1d. per gal.

Naphthalene.—Purified crystals, £9 10s. per ton in bags. Crude, Hot Pressed, £6 5s. per ton.

Pitch, medium, soft.—80s. per ton, in bulk at makers' works.

Pyridine.—90/140,—4s. 3d.—5s. 6d. per gal.; 90/180—2s.—2s. 3d. per gal.

Toluole.—90%, 2s. 4d. per gal. Pure, 2s. 9d. per gal.

Xylol.—2s. 2d.—2s. 3d. per gal. Pure, 2s. 4d.

PHARMACEUTICAL AND PHOTOGRAPHIC MATERIALS

Acid, Acetic, Pure 80%.—£39 5s. per ton d/d address U.K. *in casks.*

Acid, Acetyl Salicylic.—2s. 9d.—2s. 11d. per lb., according to quantity.

Acid, Benzoic, B.P.—1s. 9d.—1s. 11d. per lb. Solely ex Gum.—1s. 3d.—1s. 6d. *per oz.; 50-oz. lots*, 1s. 3d. per oz.

Acid, Boric, B.P.—Cryst., £35 10s. per ton. Powder, £36 10s. per ton. Ex-Fine Powder, £38 10s. per ton. For 1-ton lots and upwards, packed in 1-cwt. bags, carriage paid any station in Great Britain.

Acid, Camphoric.—19s.—21s. per lb.

Acid, Citric.—9½d. per lb. Less 5%.

Acid, Gallic.—2s. 9d. per lb. for pure crystal in 1-cwt. lots.

Acid, Molybdic.—5s. 3d.—5s. 9d. per lb., according to quantity.

Acid, Pyrogallic. Cryst.—6s. 9d. per lb. for 1-cwt. lots. Resublimed.—8s. 6d. per lb. for 28-lb. lots d/d.

Acid, Salicylic.—B.P. pulv., 1s. 7d.—1s. 10d. per lb. Technical, 1s. 2d.—1s. 4d. per lb.

Acid, Tannic, B.P.—3s. 9d. per lb.

Acid, Tartaric.—11¾d. per lb. Less 5%.

Acetanilide.—1s. 5d per lb.

Ammon. Benzoate.—3s. 3d.—3s. 9d. per lb.

Ammonium Hippurate.—19s. 6d.—23s. 6d. per lb.

Ammonium Iodide.—10s. per lb.

Ammonium Molybdate.—5s.—5s. 6d. per lb., according to quantity.

Argent. Nitras, Crystal.—1s. 1d. per oz.

Arsenic Iodide.—22s. 6d.—25s. per lb.

Benzonaphthol.—3s. 3d.—3s. 9d. per lb.

Berberine, Hydrochloride.—5s. 6d.—6s. per oz.; Sulphate, 5s. 6d.—6s. per oz.

Bismuth Salts.—Carbonate, 7s. 5d. per lb.; Citrate, 10s. per lb.; Nitrate cryst.), 5s. 2d. per lb.; Oxide, 11s. 7d. per lb.; Salicylate, 8s. 4d. per lb.; Subchloride, 11s. 4d. per lb.; Subgallate, 7s. 11d. per lb.; Subnitrate, 6s. 7d. per lb. Above for cwt. lots. Extra and reduced prices for smaller and larger quantities respectively. Liquor Bismuthi, P.P., in W. Qts.—1s. 1½d. per lb.; 6 W. Qts.—11d. per lb.; 12 W. Qts.—9½d. per lb.; 36 W. Qts.—9d. per lb.

Borax, B.P.—Crystal, £24 10s. per ton. Powder, £25 per ton. For 1-ton lots and upwards, packed in 1-cwt. bags, carr. paid any station in Great Britain.

Bromides, B.P.—Ammonium.—1s. 10d. per lb. Potassium.—1s. 7d. per lb. Sodium.—1s. 9d. per lb. Prices for 1-cwt. lots.

Cadmium Iodide.—14s. 6d. per lb.
Calcium Hippurate.—26s.—30s. per lb.
Calcium Iodide.—20s. per lb.
Calcium Lactate, B.P.—1s. 2d.—1s. 4d. per lb., according to quantity.
Camphor.—Refined flowers, 3s. 1d.—3s. 2d. per lb. *Transparent tablets*, 3s. 4d.—3s. 6d. per lb., according to quantity; also special contract prices.
Chloroform. 2s. 3d.—2s. 8d. per lb.
Cinchophen—11s. 6d.—12s. 6d. per lb.
Cocaine, Alkaloid and Citrate.—For export.—29s. 10d. 31s. 7d per oz. Hydrochloride and Nitrate, 27s. 1d. 28s. 11d. per oz.
Ephedrine hydrochloride. 5s. 6d.—6s. per oz.
Ergosterol.—2s. 6d. per gm.
Ethers. S.G. 730, 1s. 1d.—1s. 2d. per lb., according to quantity, and other prices according to specific gravity.
Hexamine. 2s. 4d. 2s. 6d. per lb., according to quantity.
Hippuric Acid.—17s. 6d.—21s. 6d. per lb.
Hydrogen Peroxide (12 vols.). 1s. 4d. per gal., f.o.r. makers' works, naked. B.P.—10 vols., 2s.—2s. 3d. per gal.; 20 vols., 3s. per gal.
Hypophosphites. Calcium, 2s. 9d.—3s. 2d. per lb. Potassium.—3s. 4d.—3s. 9d. per lb. Sodium, 2s 11d.—3s. 4d. per lb.
Iodine Resub., B.P.—9s.—11s. per lb.
Iodoform, B.P., Cryst., Precip. or Powder.—10s. 9d.—13s. 7d. per lb.
Iron Ammon. Citrate.—B.P.—1s. 9d. per lb. for 28-lb. lots Green, 2s. 5d. per lb. (list price)
Iron Perchloride.—18s.—20s. per cwt., according to quantity.
Iron Quinine Citrate, B.P. 10½d.—11¼d. per oz., according to quantity.
Lithium Carbonate, B.P., 1911.—5s. 4d. per lb.
Lithium Chloride, *Cryst.*—8s. 3d. *per lb.*
Lithium Citrate. 5s. 3d. per lb. Powder.—5s. 6d. per lb.
Lithium Hippurate.—18s. 6d.—22s. 6d. per lb.
Lithium Iodide. 20s. 6d.—21s. 6d. per lb.
Magnesium Carbonate.—Light, 28s. per cwt.
Magnesium, Oxide.—*Light*. 70s. per cwt.: Heavy 1s. 8d. per lb.; in quantity lower.
Menthol.—A.B.R., *recryst.*, B.P., 15s. per lb. net. Synthetic, 8s. 6d.—12s. per lb. Synthetic detached crystals, 8s. 6d.—10s. 6d. *per lb., according to quantity*; Liquid (95%), 8s. 6d. per lb.
Mercurials, B.P.—Red oxide crystals, 5s. 10d.—5s. 11d. per lb.; Levig. 5s. 4d.—5s. 5d. per lb.; Corrosive *sublimate*, *Lump*, 4s.—4s. 1d. per lb.; Powder. 3s. 8d.—3s. 9d. per lb.; White precip., Lump, 4s. 9d.—4s. 10d. per lb.; Powder, 4s. 11d.—5s. per lb.; Calomel, 4s. 9d.—4s. 10d. per lb. Yellow Oxide, 5s. 2d.—5s. 3d. per lb.; Persulph., B.P.C., 4s. 11d.—5s. per lb.; Sulph. nig., 4s. 10d.—4s. 11d. *per lb. Special prices for larger quantities.*
Mercury, Benzoate.—8s. 3d. per lb.; Cyanide, 12s. 7d.—13s. 1d. per lb.; Oleate (5%), 1s. 11d.—2s. 2d. per lb.; (10%), 2s. 9d.—3s. per lb.; (20%), 3s. 9d.—4s. per lb. Protonitras, 6s. 9d. per lb.; Protosulphate, 7s. 3d. per lb.; Subsulphate flav., 7s. 1d. per lb.
Methyl Salicylate.—1s. 4½d.—1s. 6½d. per lb.
Paraformaldehyde.—1s. 3d.—1s. 5d. per lb.
Paraldehyde.—1s. 3½d.—1s. 9d. per lb., according to quantity.
Phenacetin.—4s.—4s. 6d. per lb.
Phenolphthalein.—4s. 5d.—5s. 8d. per lb.
Potass. Bitartrate.—99/100% (Cream of Ta 80s. per cwt., less 2½%.
Potass. Citrate.—B.P., 1s. 7d. per lb. for 28-lb. lo
Potass Ferricyanide.—1s. 7½d. per lb., in 125-lb.
Potass. Iodide, B.P.—8s. 3d.—10s. 3d. per lb., acco to quantity.
Potass. *Permanganate*.—8¼d. per lb. for 1-ton lots
Potass. Metabisulphite.—50s. per cwt. d/d Lo kegs free.
Potassium Hippurate.—26s.—30s. per lb.
Quinine Sulphate.—2s. per oz., for 100-oz. tins; free.
Saccharin.—37s. 6d. per lb., and lower in quantity
Salicin.—15s.—16s. per lb., according to quantity.
Santonin, *B.P.*—28s. per oz.
Seidlitz powder (pulv.).—55s.—58s. 9d. per cwt.
Silver Nitrate.—1s. 3¾d. per oz. for quantity. St 2d. per oz. extra.
Sod. *Barbitonum*.—13s.—15s. per lb.
Sod. Benzoate, B.P.—1s. 9d.—2s. 3d. per lb., acco *to quantity*.
Sod Citrate, B.P.C., 1911.—1s. 4d. per lb. B. 1932, *and* U.S.P.—1s. 8d. *per lb. for* 28-lb. *lots*
Sodium Hippurate.—23s. 6d.—27s. 6d. per lb.
Sod. Hyposulphite.—Photographic, £15 *per ton* consignee's station. in 1-cwt. kegs.
Sodium Iodide, B.P.—8s. 6d.—10s. 6d. *per* lb.
Sod. Nitroprusside.—16s. per lb.
Sod. Potass. Tartrate (Rochelle Salt).—65s. per net for 1-ton lots. Crystals, 2s. 6d. per cwt. e
Sod. Salicylate.—Powder, 2s.—2s. 8d. per lb. Cry 2s. 1d.—2s. 9d. per lb.
Sod. Sulphide.—Pure recryst., 10d.—1s. 2d. per lb.
Sod. Sulphide anhydrous.—£23—£25 per ton, accor to quantity, d/d U.K.
Tartar Emetic, B.P.—3s. 9d.—4s. 6d. per lb.
Terpine hydrate.—1s. 2d.—1s. 5d. *per lb.*
Thymol, Puriss.—5s. 9d.—6s. 6d. per lb., accordin quantity. Natural.—12s. per lb.
Zinc Stearate.—1s. 3d.—1s. 8d. per lb.

PERFUMERY CHEMICALS

Acetophenone.—7s. per lb.
Aubepine (*ex Anethole*).—8s. per lb.
Amyl Acetate.—2s. 3d. per lb. Amyl Butyrate.—per lb. Amyl Cinnamic Aldehyde.—8s. 3d. per Amyl Salicylate.—2s. 9d. per lb. Anethol, 21 C., 4s. 9d. per lb.
Benzaldehyde free from Chlorine.—2s. 9d. per lb.
Benzyl Acetate from Chlorine-free Benzyl Alcoh 2s. per lb. Benzyl Alcohol free from Chlorin 2s. per lb. Benzyl Benzoate, 2s. 3d. per lb.
Cinnamic Aldehyde.—Natural, 12s. 3d. per lb.
Citronellol.—8s. 6d. per lb.
Citral.—7s. per lb.
Coumarin.—15s. per lb.
Ethyl Cinnamate.—8s. 6d. per lb.
Ethyl Phthalate.—2s. 6d. per lb.
Eugenol.—7s. 3d. per lb. Geraniol (Palmarosa 17s. per lb. Geraniol.—6s. 6d.—11s. per Heliotropine.—6s. per lb. Iso Eugenol.—8s. 6d. lb. Linalol.—(*ex Bois de Rose*), 6s. 3d. per l (*ex Shui Oil*) 5s. 6d. per lb. Linalyl Acetate.—*Bois de Rose*), 7s. 6d. per lb.—(*ex Shui Oil*) 6s. per lb.
Methyl Anthranilate.—9s. per lb.
Methyl Benzoate.—4s. 6d. per lb.

k Ketone.—33s. per lb.
k Xylol.—8s. per lb.
lin.—5s. per lb.
yl Ethyl Acetate.—10s. per lb.
yl Ethyl Alcohol.—8s. 6d. per lb.
inol.—60s. per lb. Safrol.—1s. 6d. per lb. Terpineol.—2s. per lb. Vanillin (*ex Clove Oil*).—16s.—18s. per lb.—(*ex Guaiacol*)—14s. 3d.—16s. 3d. per lb.

ESSENTIAL OILS

nd.- Foreign S.P.A., 9s. per lb. Anise.—2s. 1d. per lb. Bergamot.—7s. per lb. Bourbon Geranium.—24s. 3d. per lb.
phor.—Brown, 65s. per cwt.—White, 95s. per cwt.
Cananga, Java, 10s. per lb. Cinnamon Oil, Ceylon, 5s. 3d. per lb. Cassia, 80/85%, 4s. 3d. per lb.
nella Oil.—Java, 2s. 4d. per lb. Ceylon, 2s. 3d. per lb. Clove.—90/92% English, 4s. 3d. per lb.
lyptus, Australian B.P., 70/75%.—1s. 2d. per lb. Lavender.—Mont Blanc, 38/40%.—16s. per lb. Lemon.—5s. per lb. Lemongrass.—4s. per lb. Orange, Sweet.—6s. 6d. per lb. Otto of Rose.—Anatolian, 33s. *per oz.; Bulgarian,* 45s. *per oz.* Palma Rosa, 8s. per lb.
permint.—Japanese, 5s. per lb. Wayne County, 13s. 6d. per lb. Petitgrain.—4s. 9d. per lb.
dalwood, Mysore.—30s. per lb. 90/92%, 20s. per lb. Australian, B.P. and French Codex, 92/95%, 15s. 6d. per lb.

INTERMEDIATES

Items marked thus * d/d buyers' works.

id Benzoic, 1914 B.P. *ex Toluol*.—1s. 9½d. per lb. in casks.
id Gamma.—Spot, 4s. per lb., 100%.
id H.—Spot, 2s. 4½d per lb., 100%.
id Neville and Winther.—Spot, 3s. per lb., 100%.
id Sulphanilic, 8d. per lb.
iline Oil, spot, 8d. per lb., drums extra.
nline Salts, spot, 8d. per lb., casks free.
nzaldehyde, spot, 1s. 8d. per lb., packages extra.
nzidine Base.—Spot, 2s. 5d. per lb., 100%.
resol 30/31° C.—£2 6s. 5d. per cwt. in 1-ton lots.
resol 98/100%.—2s. 3d. per lb., in ton lots.
resol 34.5° C.—1s. 9d. per lb., in ton lots.
hloraniline.—2s. 3d. per lb.
methylaniline.—Spot, 1s. 6d. per lb., packages extra.
itrobenzene.—8d. per lb.
itrotoluene 48/50° C.—8d. per lb. 66/68° C.—9d. per lb.
phenylamine.—Spot, 2s. per lb.
Naphthol.—Spot, 2s. 4d. per lb.
Naphthol.—Spot, £78 15s. per ton, in paper bags; £79 15s. per ton in casks, in 1-ton lots.
Naphthylamine.—Spot, 11½d. per lb.
Naphthylamine.—Spot, 2s. 9d. per lb.
traniline.—5s. 10d. per lb.
Nitraniline.—2s. 7d. per lb.
Nitraniline.—Spot, 1s. 8d.—2s. 1d. per lb.
trobenzene.—Spot, 4½d. per lb., 5-cwt. lots, drums extra.
ronaphthalene.—9d. per lb.
dium Naphthionate.—Spot, 1s. 9d. per lb., 100%.
Toluidine.—Spot, 1s. 11d. per lb.
Toluidine.—Spot, 9½d. per lb., drums extra.
Xylidine acetate, 3s. 4d. per lb., 100%.

PATENT LIST

The following is a list of complete specifications of chemical interest which are open for inspection under Section 91 (4) (a) of the Patent Acts. Printed copies are not available, but photographic copies may be obtained at a charge of 8d. per page (minimum 1s.) from the Patent Office, Chancery Lane, W.C.2.

I. 2580 (1933). Smith. *See* **XXIII.**
7701 (1933). Brit. Celanese, Ltd. Filters and methods of filtration.
7709 (1933). Melitta-Werke. Filtering devices.
7779 (1933). A.C. Spark Plug Co. Quantitative spectral analysis.
7869 (1933). Hanseatische Muhlenwerke. Treatment of materials comprising volatile constituents.
7999 (1933). Distillation Dynamique. Condensation, distillation, and other industrial processes.
25,613 (1933). Industrikemiska Aktieb. Evaporation, saturation, absorption, washing, heat exchange, etc.

II. 5567 (1933). Standard Oil Co. Separating wax from oil.
8108 (1933). Winckler. *Gasification of liquid fuel.*

III. 7748 (1933). I. G. Farbenind. Manufacture of 1 : 4-diamino-2-aryloxyanthraquinone-3-sulphonic acids.
7875 (1933). Reichsmonopolverwaltung f. Branntwein. Obtaining anhydrous ethyl and methyl alcohol from crude spirit.
8021—2 (1933). Du Pont de Nemours & Co. Manufacture of naphthoylbenzoic acid derivatives.
8381 (1933). I. G. Farbenind. *See* **IV.**
8395 (1933). Deutsche Hydrierwerke A.-G. *See* **VI.**

IV. 7465 (1933). Chem. Fabr. vorm. Sandoz. Water-soluble dyestuffs of the anthraquinone series.
8381 (1933). I. G. Farbenind. Manufacture of dyes and intermediates therefor, and sensitization of photographic emulsions therewith.

V. 7455—7 (1933). Chem. Fabr. vorm. Sandoz. Delustring natural and artificial silks.
7700 (1933). Brit. Celanese, Ltd. Manufacture or treatment of cellulose products.
8034 (1933). Heberlein & Co. *See* VI.

VI. 4833 (1933). Internat. Paper Co. Continuous bleaching processes and apparatus.
5605 (1933). Toeller and Bothmer. Colouring carpet fabrics.
7466—7 (1933). Chem. Fabr. vorm. Sandoz. *See* **V.**
8034 (1933). Heberlein & Co. Treatment of vegetable fibrous materials.
8395 (1933). Deutsche Hydrierwerke A.-G. Wetting-out, washing, cleansing, frothing, and dispersing agents.

VII. 7356 (1933). Ges. f. Kohlentechnik. Production of hydrocyanic acid.
8365 (1933). Jourdan. Obtaining alkaline hydrates from silicates.
8366 (1933). Jourdan. Treatment of silicates with acids to obtain their soluble salts.

X. 30,631 (1932). Amer. Rolling Mill Co. Iron or steel alloys.
30,632 (1932). Amer. Rolling Mill Co. Ferrous metal.

XI. 7577 (1933). I. G. Farbenind. Electrolytic cells and processes.
7752 (1933). Pressler. Photo-electric cells.
7878 (1933). I. G. Farbenind. Electrolytic cells.
8119—20 (1933). Chilowsky. Selenium and like cells.

XII. 5976 (1933). Bizzell and Bizzell. *See* **XIX.**
8395 (1933). Deutsche Hydrierwerke A.-G. *See* VI.

XIII. 7532 (1933). Celluloid Corp. Manufacture of thermoplastic materials.
7643 (1933). Pitzer. Making resinous condensation products.

XIV. 35,426 (1932). Goodyear Tire & Rubber Co. Preservation of rubber.

36,298 (1932). Goodyear Tire & Rubber Co. Treatment of rubber.

7173 (1933). Du Pont de Nemours & Co. Manufacture of rubber having age-resisting properties.

7884 (1933). Lebedenko, Naphtali, Kroll, and Meyer. Solutions of vulcanized rubber in organic solvents.

XVIII. 7875 (1933). Reichsmonopolverwaltung f. Branntwein. *See* III.

XIX. 5976 (1933). Bizzell and Bizzell. Treating edible nuts.

XX. 7621 (1933). I. G. Farbenind. Manufacture of muscle adenylic acid.

XXI. 8185 (1933). Bonneau. Kinematography in colours.

8381 (1933). I. G. Farbenind. *See* IV.

XXIII. 2580 (1933). Smith. Purification of liquids.

GENERAL NOTES

Official Trade Intelligence

The Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1, has *received the following inquiries for British goods.* British firms may obtain further information by applying to the Department and stating the specific number. *Australia:* Aniline dyes (334) *Belgium:* Ferro-alloys, *silica refractory products* (349); Second-hand barrels for glucose and oil (352). *Bulgaria:* Tinplates, blackplates (G.Y. 13,002). *Hungary:* Chemicals, pharmaceutical preparations (361). *New Zealand:* Air compressors (343). *Norway:* Soap and chemical factories (363). *Peru:* Cement (370). *Uruguay:* Lubricating oils (B.Y. 7666).

Key Industry Duty

A representation has been made to the Board of Trade under Section 10 (5) of the Finance Act, 1926, regarding apparatus for measuring carbon dioxide evolved during fermentation. Under Section 10 (5) of the Finance Act, 1926, the Treasury may exempt from duty for a specified period any article in respect of which the Board of Trade are satisfied that manufacture in any part of the Dominions is not substantial having regard to consumption, and that there is no probability that the article will be made in substantial quantities.

Any communication should be addressed to the Principal Assistant Secretary, Industries and Manufactures Department, Board of Trade, Great George Street, London, S.W.1, before September 28, 1933.

Messrs. Harrison & Sons, Ltd.

In connexion with the notices which have recently appeared in the Press regarding the new contract obtained by Messrs. Harrison & Sons, Ltd. for the supply of British postage stamps, it has now been decided that all denominations up to one shilling in value are to be produced by the photogravure process.

An interesting point is that the new contract commences in the centenary year of the adhesive postage stamp, for in 1834 the first postage stamp was produced experimentally by James Chalmers of Dundee. Mr. Perkins, of Messrs. Perkins, Bacon & Co., Ltd., afterwards employed the steel plate recess method of printing postage stamps and during the first 40 years of the reformed postal system his firm produced an average of a little over 600 million penny adhesive stamps annually.

At the present time about 230 tons of paper and 1[illegible] tons of gum are required to produce one year's supply, a total of approximately seven thousand million stamps made up of various denominations, a value of about £38,000,000. The adhesive is pure gum arabic imported from the Sudan. The gum is obtained from the acacia tree, the bark cut and later the nodules of gum are knocked off by the natives, left to dry in the sun, gathered and sent to Khartoum, from which centre it is despatched to the consumer.

Hydrogen-Ion Determination

The many chemists engaged in research, in the control of manufacturing processes, or in analytical work, who find it necessary to know the p_H values of the liquids with which they deal will find two booklets recently published by British Drug Houses, Ltd., Graham Street, London, N.1, to be useful and handy for reference. One of them, entitled "p_H Values," is the third edition of a booklet that is already so well known in every laboratory as to need no further comment. The other is a catalogue of B.D.H. indicators, and includes particulars of buffer solutions, the B.D.H. capillator, and travelling outfits for p_H testing. The B.D.H. comparator containing a range of standard buffer tubes is provided with a moulded bakelite case which [illegible] compact and completely encloses the tubes, so that there is no risk of breakage. The Lovibond comparator which is illustrated, is produced in co-operation with The Tintometer, Ltd. and is ideal for quick determinations.

Tool-Room Tempering Equipment

A leaflet issued by Birmingham Electric Furnaces Ltd., of the Birlec Works, Tyburn Road, Erdington, Birmingham, describes a new production, a small vertical tempering furnace. Though very compact and occupying little floor space, the furnace has a very complete equipment, including automatic temperature control, temperature indicating instrument, and a complete switch panel fitted with pilot lights. The "JFC" as this new small model is called, is made in two types, one being suitable for temperatures up to 400° C. and the other up to 650° C. The construction of the furnace itself is identical for either range and the design of the temperature regulator forms the only difference between the two. While, therefore, the low-temperature model is suitable for tempering carbon steel parts the high temperature pattern covers the whole range of tool-room tempering both of carbon and high-speed steel.

Industrial Equipment

A booklet just issued by Mining & Industrial Equipment, Ltd., of 11, Southampton Row, London, W.C. is a handy guide to the Hum-mer screens made by the company in its Derby works. The complete range of screens is dealt with and the suitability of each for special purposes is discussed. A number of excellent photographs show the screens and some typical installations.